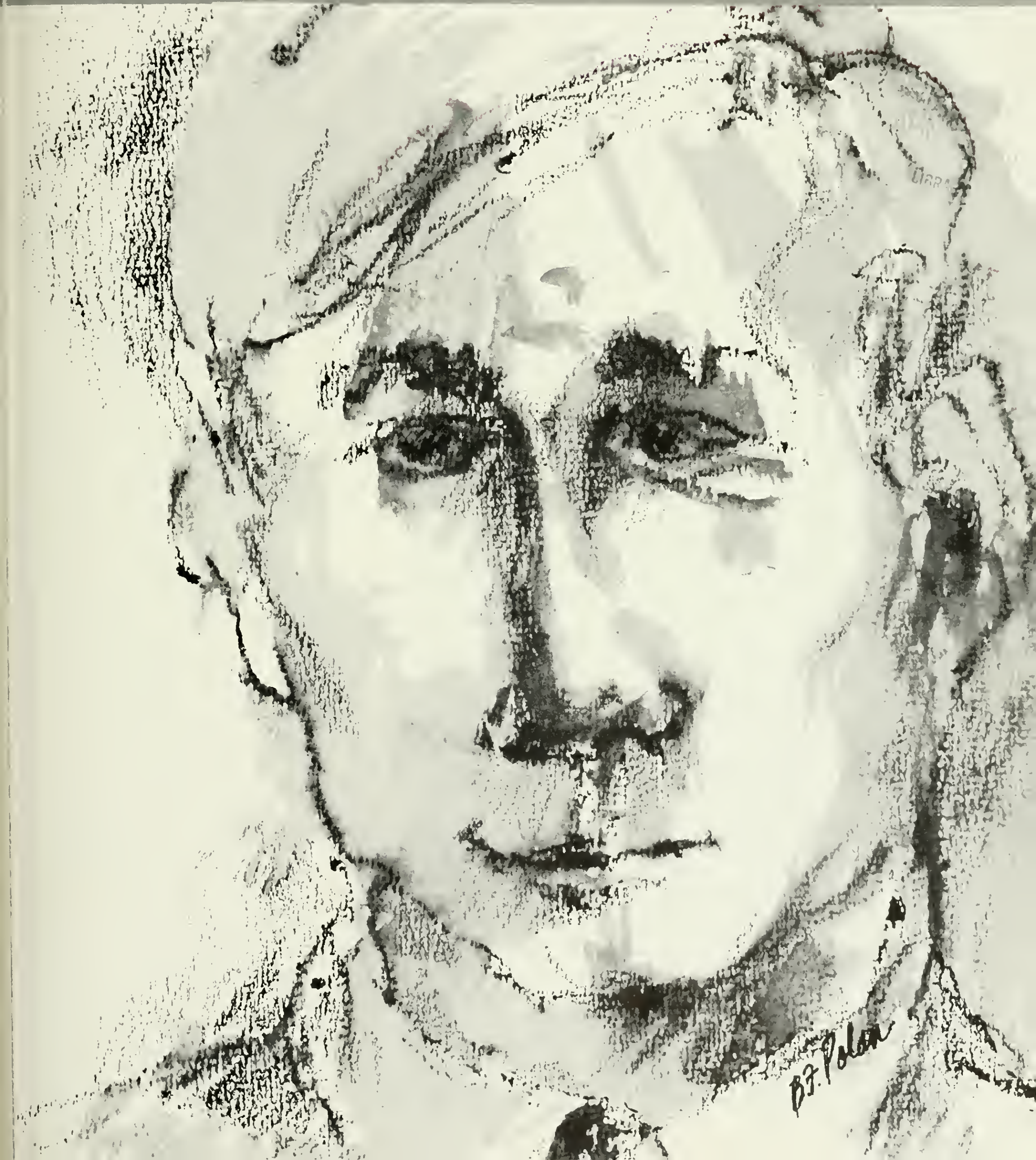
ILLINOIS

February · 25¢

TECHNOGRAPH



THE ILLINOIS TECHNOGRAPH

Volume 75, Number 5 February, 1960

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Cover . . .

Pictured on this month's cover is a "pensive young man" studying engineering who might someday become a writer also. For more about engineers in the writing field turn to page 14.

—Barbara Polan

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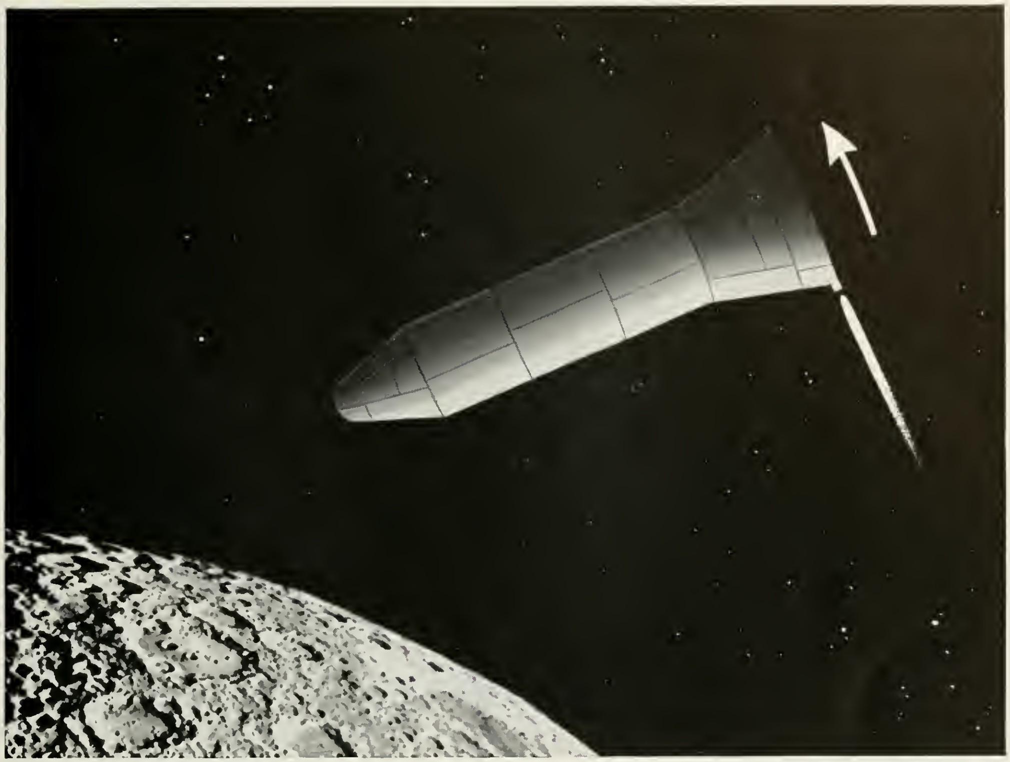

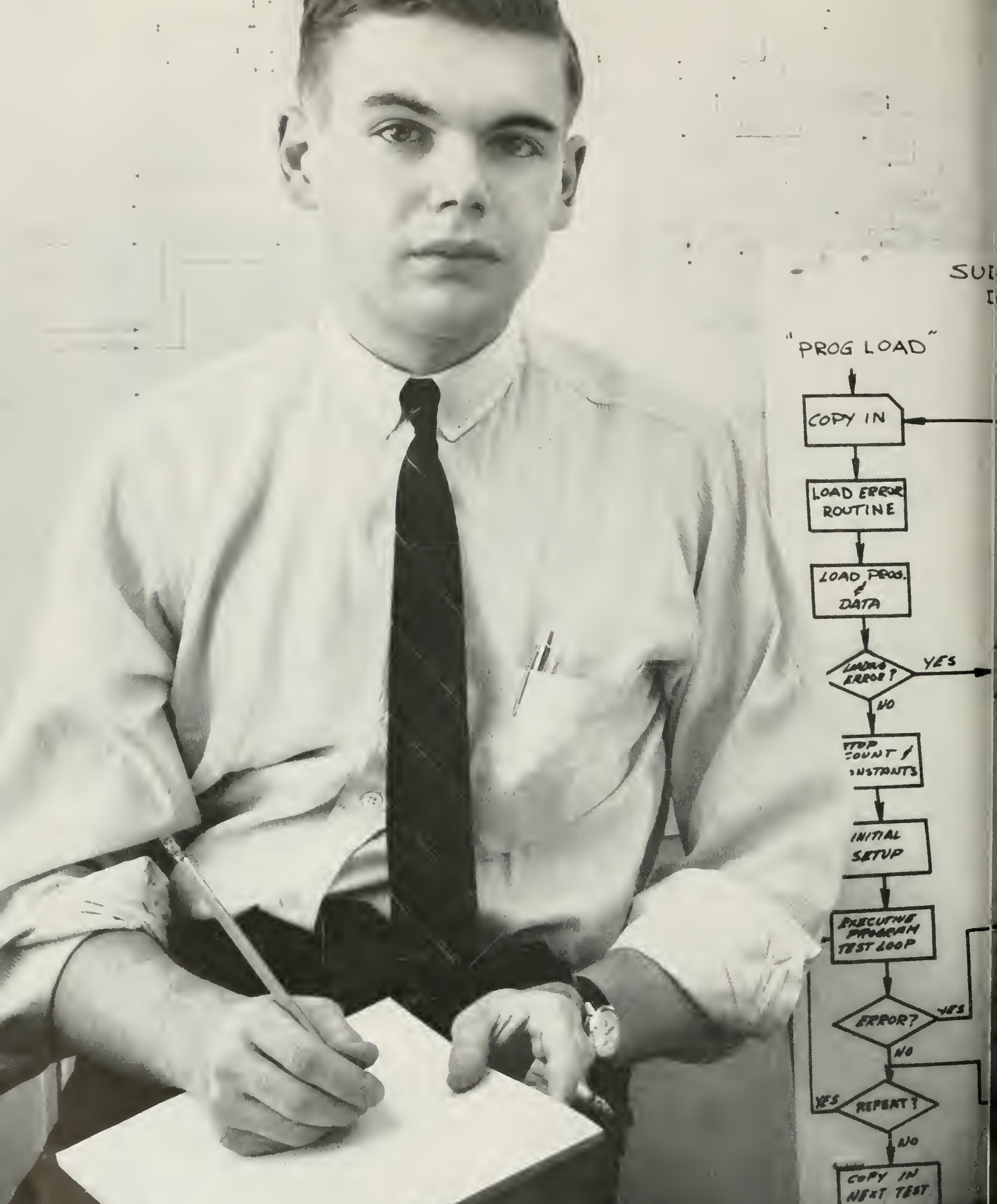

Robert M. King (B.S.E., Princeton '57, M.S., Carnegie Tech) is investigating applications of the electronic computer in advanced compute design. A skilled computer programmer, he has done original work in organizing programs that make possible computer self-diagnosis

HE GETS COMPUTERS TO DIAGNOSE THEIR OWN FAULTS

With the increasing size and complexity of modern computers, one of the most interesting problems that engineers face is the rapid and efficient location of failures within the system.

The method which they have found most practical is to use the speed and logical abilities of the computer itself to make the diagnosis. Programming computers to perform this function is the job of Robert M. King.

The Diagnostic Technique

He prepares programs for the computer which actually simulate the deductive processes of a man investigating the faults of the machine. Each program instructs the computer to exercise various segments of its circuitry in a logical order.

The result of each test is checked against the correct result, stored in the computer memory, of previous tests of the same circuitry when in proper working order. If the results do not agree, a message is automatically typed which indicates the failure and which component caused it.

A computer is particularly adept at this job. It can take into consideration simultaneously a large number of factors. It can also work at very high speeds. Once a program is properly written, the computer makes no errors. Appropriately enough, diagnostic programming often aids in designing better computers.

A Programmer's Background

Computer programs are the result of ingenious applications of many intellectual qualities. Computer design and language are based on sound laws of logic. Therefore an important prerequisite is the ability to analyze complex problems and to deduce from them useful methods of solution consistent with machine requirements.

If you think you might be interested in working in one of the many fascinating areas of computer programming, you are invited to talk it over with an IBM representative. The future can be as unlimited as the future of the computer itself.

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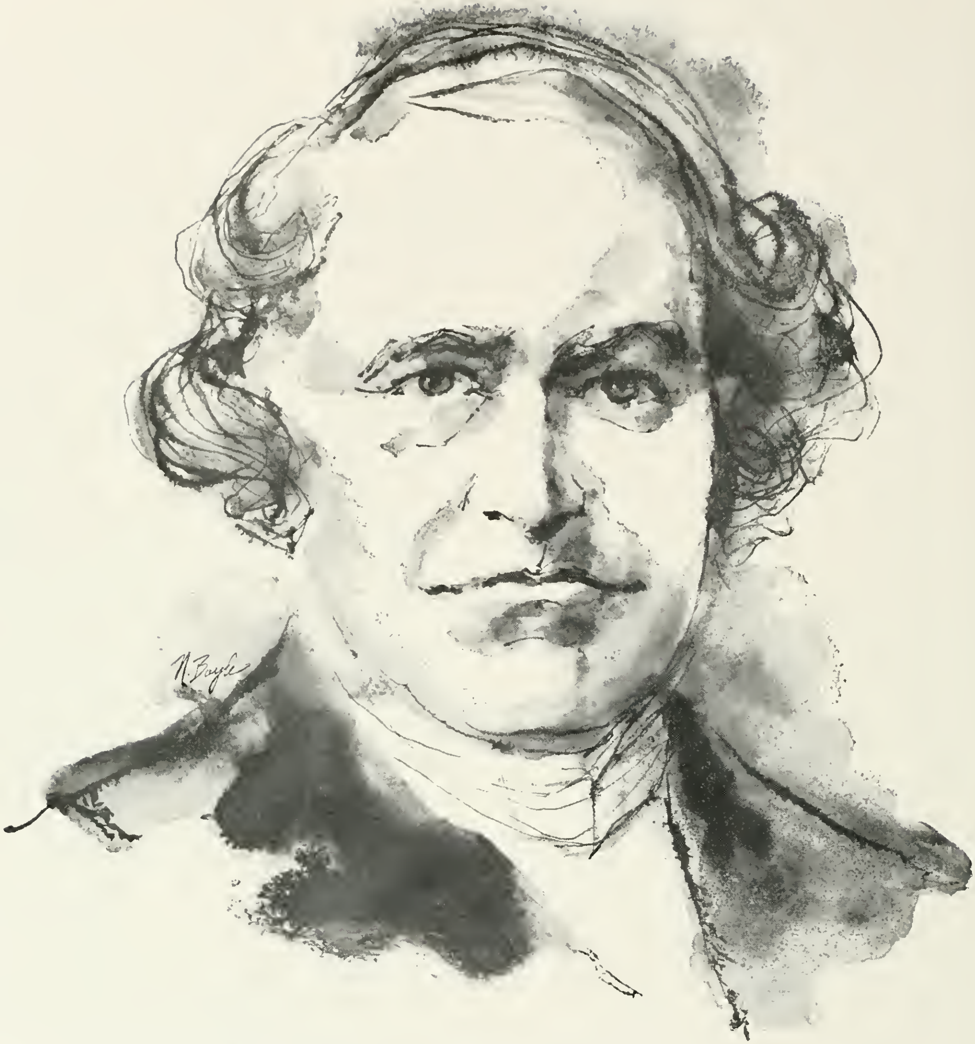


William Whewell...on mind and matter

"...these metaphysical discussions are not to be put in opposition to the study of facts; but are to be stimulated, nourished and directed by a constant recourse to experiment and observation. The cultivation of ideas is to be conducted as having for its object the connexion of facts; never to be pursued as a mere exercise of the subtlety of the mind, striving to build up a world of its own, and neglecting that which exists about us. For although man may in this way please himself, and admire the creations of his own brain, he can never, by this course, hit upon the real scheme of nature. With his ideas unfolded by education, sharpened by controversy, rectified by metaphysics, he may *understand* the natural world, but he cannot *invent* it. At every step, he must try the value of the advances he has made in thought by applying his thoughts to things."

—*Philosophy of the Inductive Sciences, 1847*

Room for One More

If you have taken a look at the table of contents, you will have seen that this issue leans heavily toward the engineer as an individual. We have included two essays and several articles concerning human interest and human factors that must be considered in your professional future.

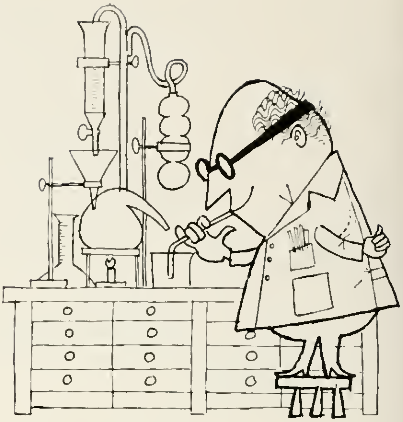
These articles, we hope, will whet your interest in yourself. You must think of yourself as a unique person with ideas and feelings of your own. If you are a senior and have started interviewing, you will begin to realize the pitfalls open to you. Conformity is an easy rut to travel. The men interviewing you represent companies which in essence are strange new worlds. One of these unknown worlds contains a place for you: a rut if you make it so.

In your first effort to fit into the company you may find conformity the easiest method. Questions such as: "Should I join the company country club? Should I stock up on the 'tailored look' suits?" may become more important than you think now. Sure you've been a self-made man and grown a beard, or gone beat for a month, but these are very weak memories to cling to when you become part of an organization.

Conformity of the mind is the real danger for which to be on the alert. You have come from college relatively unspoiled in that your mind is still pliable. You should be alert for new areas of knowledge and grasp at new facts, but don't grasp at the first pattern of operational procedure.

This may fit you into the cocktail club at noon and the poker club at night, however it will stifle your chance of **making room** in the true professional field of engineering. There is no niche for you there; you have to make a place for yourself.

WDP



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WANTED:

Engineers Who Can Write

By Verne Moberg

Industry needs engineers who can express themselves.

And the student engineer can most profitably spend the little spare time available during his undergraduate years by learning to write. He may even double his income.

Why is it, then, that the earmark of engineers on the Illinois campus is that they can't write or speak well?

Who knows?

But the truth is, engineers both in industry and on college faculties insist that self-expression is almost *the* important skill student engineers need to learn. And they *can* learn to write—which is a first step in communication—with only a little effort through concentrating on some basic principles, staying awake in rhetoric class and getting in some practice writing.

You don't believe that you can learn to write or need to do it? First let's see what professional engineers have to say about the need for expression.

John Isaacson, manager of college relations at the IBM Product Development Laboratory, Poughkeepsie, N. Y., who was interviewed at Illinois this fall, says that the way an idea is expressed is almost as important as the idea itself.

"If you can't communicate, you may as well give your ideas away. We'd have to hire two people instead of one."

The people who communicate, Isaacson says, are the ones who make the grade in tangible rewards, "prestige, responsibility and the dollar," as well as intangibles (pride of a job well done).

G. H. Duff, Westinghouse central Illinois branch sales manager, Peoria, agrees. About 85 per cent of the Westinghouse personnel in management posts began as engineers who were able to put across their ideas effectively.

And here's how engineering college faculty rate communication skills.

According to Prof. T. J. Dolan, head of the U. of I. Department of Theoretical and Applied Mechanics, "The principal job of an engineer is to sell his ideas and to sell himself. If he can't do this, he may as well give up trying to be a professional engineer."

Other engineering educators say communication skill is more important for the engineer than for a man in pure science, because he must sell his ideas to all kinds of people—politicians, economists and businessmen of all kinds, including other engineers.

Yes, they care. And like girlfriends, instructors want to know *you* care—even about the little things.

One professor in the T. & A. M. department even confides that concise, straightforward presentation ought to be just as important as technical mastery to a student who wants high grades on his papers. Instructors are human too, and they're naturally impressed when you turn in a paper that says what you mean in crisp, clean language.

All right, so they all care. But exactly how much is the big payoff.

Louis N. Rowley, editor and publisher of "Power," technical magazine of McGraw-Hill Co., Inc., declares that, "other things being equal, skill with words and speech will add anywhere from $50,000 to $200,000 to an engineer's lifetime earnings."

Prof. G. M. Sinclair, research director of the T. & A. M. Fatigue Laboratory, calls Rowley's guess conservative. Effective communication skill, he says, will probably double an engineer's lifetime income.

Estimates vary, but all professionals agree, the dollars increase.

Of course, an engineer can get a job without knowing how to express himself, according to Isaacson.

"But he'd better be Einstein," he warns quickly. "He'll have to make up to the company what it's paying another man to interpret him. Einstein could communicate his more complex theories to very few men. But that was Einstein. The ideas most engineers come up with every day aren't that good."

If you know you're no Einstein, but still think engineers at Illinois don't have to learn to write, don't go near Prof. JoDean Morrow in the T. & A. M. department. "People like that are second-rate technical clowns," he feels. "Either you have professional pride or you don't."

So you want to be an engineer? So you'd better learn to write. If you'll put down that slide rule, you can start right now.

The first thing to keep in mind is that language, like a beautiful bridge, is a functional structure. It is designed to carry across ideas with economy and grace. The best technical writing, like the finest literature, is short and sweet.

As engineers, you have a headstart here over students in liberal arts because you're used to thinking in this strictly organized, functional way. So when you're designing, molding and refining the parts of language, which are paragraphs, sentences and words, always remember these basic principles.

1. All the parts must be there, or communication won't take place.

2. All the parts must be functional; useless parts just get in the way and slow up understanding.

3. The structure (paper or literary work) with the fewest parts works the best and lasts longest.

Before you begin to formulate what you have to say, put these in mind and you'll have an overall frame to simplify your thoughts.

In producing good writing you'll concentrate on three basic processes: designing, molding, and refining your thoughts, or as rhetoric teachers will say, organizing, writing and reviewing (correcting and/or revising). Each one is important, and none can be left out—not even in an impromptu theme for rhet class. If, at any one of these three stages, you discover that preparation at an earlier stage was faulty or incomplete, go back to it and start from there. The stage you are in will be the most important when you are in it.

First comes design. As soon as you have a topic, narrow it down. Usually in factual writing, the more words that are in your title, the smaller your subject becomes and the more specific and meaningful will be the things you say about it. Next choose a thesis—a complete sentence which expresses your general topic in its subject and the particular slant you're taking on it in the predicate—and write it down. Now decide on your purpose and your scope and write them down. Now stop.

Take a look at your audience. Who will be reading your paper? Engineering professors? Rhetoric instructors? Other professional engineers? Find out who they are, learn as much as you can about their likes and dislikes regarding the subject and, more important, know what they *can* and what they *will* read.

Robert Gunning says in his book, "The Technique of Clear Writing," that technical writing is due for a Coperican revolution. Over four hundred years ago the Polish astronomer said that the earth orbited around the sun not *vice versa*. It's about time now, says Gunning, that engineers centered their thoughts on the reader, not on themselves.

So after you've noted the aspects of your topic you'll want to cover, organize them in a pattern most agreeable and appropriate to your reader. For engineers this will generally mean a logical structure of deductive reasoning. That is, in your paper as a whole you'll state your main points and then show why they're true. For instance, you might start like this:

1. The moon is a spherical mass moving around the earth.

A. Newton said so.

B. The Russians say so(they saw its backside).

C. Walking home last night, your girlfriend agreed that the moon is a spherical mass moving around the earth (Maybe your word choice gave her that headache?)

Or you might use a time or space sequence of relating the main points in descriptive writing.

In any case, jot down the main ideas in outline form and then ask yourself, "What questions would an intelligent reader ask about my topic that I haven't covered?" Then fill in the blanks.

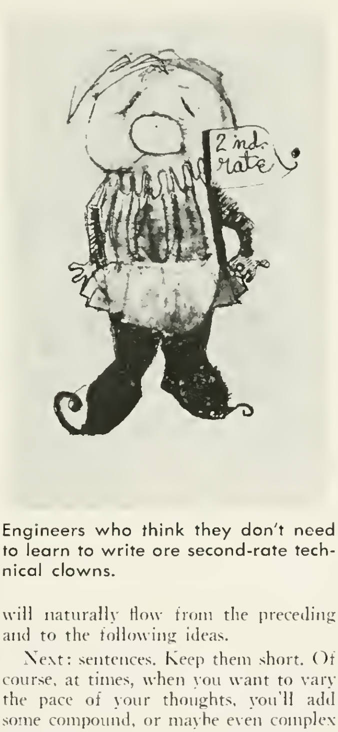
Another important factor to consider about your reader is the suitable level of language. In what situation are you addressing this person? At the college level, you will probably need to use a professional tone. This means you will stick to business and tell what happened in the most direct, objective way possible. You will not relate the experiment to your instructor or employer in the same way that you would tell your roommate, "A very funny thing happened to me in met. lab today . . ."

At the same time you don't want to strain yourself to sound "scientific" by trying to pull intellectual wool over anybody's eyes. Make it your goal to *express* what you know, not to *impress* the reader. If you can express yourself well, naturally the audience will be impressed.

Now, are you organized? All right, get it down in black and white.

Here's where the streamlining really comes in. You'll want to weigh and test everything to find the best combination of parts in each of the three functional units of expression—paragraphs, sentences and words.

The largest and simplest unit is the paragraph. As you know, it's a group of sentences tied together to give logical support to a larger section of the paper. Make sure this thought unit carries through one idea and, if possible, arrange the specific ideas at the beginning and the end of the paragraph so they



Engineers who think they don't need to learn to write are second-rate technical clowns.

will naturally flow from the preceding and to the following ideas.

Next: sentences. Keep them short. Of course, at times, when you want to vary the pace of your thoughts, you'll add some compound, or maybe even complex sentences.

If sentence structure leaves you in the dark, check a grammar book to get the facts. While you're at it, save yourself much pain in rhetoric classes by learning these general punctuation rules:

1. Almost always use a comma after an introductory dependent clause.

2. Almost always use a comma before the "and," "but," "or" or "nor" which joins two main clauses.

The rare exception occurs when the sentences are unusually short or closely related. Be safe—use the comma—and usually you'll be right.

Now that you're familiar with the terms, here's the main point. You can give your ideas weight by placing them properly. A main clause always carries the most important idea; a dependent clause, a less important one. If two ideas rate equally and are closely related, put them in a compound sentence with either a coordinating conjunction ("and," "but," "or" or "nor") or a semicolon to separate them.

Another major factor in sentence structure which can add or take away from the emphasis you want to put on your ideas is the order of the sentence elements. Unlike many other languages, English has a traditional order for parts of the sentence and that is, subject-verb-object. One, two, three; Mary loves John. If you want to put across your idea quickly and clearly, follow this order. Don't change it without one of these two good reasons: 1) The sentence sounds stilted and completely unnatural, or 2) Your sentence patterns need variation. Most important, subjects and verbs belong together, and if you can help it, don't separate the two with irrevelant words.

Likewise, modifiers—either words or phrases—belong as close as possible to elements which they complement. When your date comes down the stairs on the night of the big dance with a gorgeous new dress, you don't wait till next year to tell her about it. In the same way, readers forget what you're talking about when you tag on a modifier at the end of the sentence that refers to a word at the beginning. If you write, "The alloy melted quickly that was nitrided at 100F." you're talking nonsense. Place the modifiers right after the elements and make sense.

Finally, let's look at words, the most basic units of meaning. Once more, search for the simple, specific, familiar, concrete terms and you'll communicate faster. With the wealth of $64,000 words engineers have in their technical language, you can't afford to fog up the reader's mind with any more nontechnical syllables than necessary. So keep it short.

Since most of our short, brisk words came from the Anglo-Saxon ancestral tongue of the English language, and not the Romance languages of southern Europe, you'll to well to favor them over words of Latin, French or Spanish background.

For instance, use "come" instead of "approach" and "great" instead of "immense." The most sparkling literature in English has been composed chiefly of these words and they can help you too. In his major works, Shakespeare drew 90 per cent of his words from the Anglo-Saxon, Milton used 81 per cent and the Bible (three gospels), 94 per cent. You might not outdo these best sellers, but your paper will at least be read.

A word about word choice: say what you mean. If possible, don't say the same thing so often that your reader is bored; find synonyms to express it in a different light. Sometimes, of course, there's no more than one word for the thing you are talking about. So, for your instructor's sake, use it—it can't be helped.

One engineering professor is now recovering from a severe case of amnesia because a student in his paper refused to call an extensometer an extensometer after the first reference. The worried man searched the lab for weeks to find the other "expansion gage cage," "metallic gift-wrapped measuring device" and "deformation quantifier" which the student talked about.

Certainly the rhetoric teacher is right when he says don't bore the reader with the same term over and over; do find synonyms. But the great sin, he'll tell you, is repetition of ideas. The same word will do twice if it's the only one that fits. In engineering a spade is a spade. Likewise, an extensometer is an extensometer, and your reader will be lost if you call it anything else.

A last word on verbs: if at all possible, keep them active, not passive. When the verb is in the active voice, the subject does the acting, but with a passive verb, the subject is acted upon. This becomes much clearer through example.

Passive: The yield point was lowered by cooling the metal.

Active: Cooling the metal lowered the yield point.

Often in technical writing the personal approach, involving "I" and other personal pronouns, is left out in order to show the objectivity and reproducibility of the results. Usually this involves the passive, but it can be avoided with effort.

For example:

Don't Use: That method of testing was dispensed with to reduce argon consumption.

Do Use: A new method of testing reduced argon consumption.

As Robert Gunning says, "The need to be impersonal is not the need to be inhuman. Some writers shun the first person so much they wouldn't use 'we' to refer to the human race."

But for best results keep both the subjective and the passive elements from your writing.

Shakespeare was lucky, most engineers will think. It was not until after his time, or about 1700, that scholars began to concentrate on rules of grammar. During the eigtheenth century about 250 books were published in effort to establish "correct English."

But writing is easier with rules than without, and they can help you organize your writing. Become familiar with them if you can, but see them as they make up the overall picture, not just as a set of facts. Remember, no rule is infallible. Break any one if necessary to say exactly what you mean.

Now your paper is down in black and white—it's written. But it's not complete until after the final process of refining your thoughts.

Go back and look at your work again. Have you used the best words available

Take a look at your audience. Know what they can and what they will read.

in every case? "The difference between the right word and the almost-right," said Mark Twain, "is the difference between lightning and the lightning bug."

Would analogies or comparisons, facts, examples or quotes brighten your material? Finally, are there any questions left unanswered? Fill it out and tighten it up.

Then check out the spelling and punctuation. You've been learning the rules since grammar school. Just apply them.

Or maybe you never really learned the rules. Prof. Morrow from the T. & A. M. Department claims a four-page handwritten paper turned in to him contained a record 136 misspelled words. Those odds are almost 1:4! Wood you be annoyed if you had too read a paper with that many mispelled words? Naturally.

Save yourself a lot of time for the rest of your professional and private life and learn the simple, logical principles now. Then you won't waste time looking them up each time you're in doubt.

Some words you'll misspell over and over out of habit. List them, learn to spell them correctly and make a real effort to memorize them. Never be afraid to use a dictionary.

As for punctuation, yes, learn the rules. They'll tell you non-restrictive clauses and phrases (ones that aren't essential to the meaning of the sentence) are set off on both sides by commas. And learn the placement of quotation marks in regard to other punctuation. It's simple:

1. Always place periods and commas inside the quotation marks.

2. Always place colons and semicolons outside the quotations.

3. Place exclamation points and question marks inside or outside quotation marks, according to which unit of thought they're meant for.

To punctuate reference paper footnotes and bibliographies, see a style sheet in any good modern English text. Generally the elements of the references are listed in the descending order by which you would locate them in the library, i.e., title, volume, page, etc.

Now, if everything's correct, you can take the last step. Read your paper aloud. Does it flow or does it stumble? Make the repairs. The smoothness of your writing will be the last X factor, for once you've mastered the basics, it's your style that will win your audience. When you have reached the point at which you feel you're "just talking along"—with the proper degree of formality or casualness, of course—then you have succeeded; your reader will wish he could write that well. The paper is done.

Writing is a long but logical process and with practice, you will take these necessary steps automatically. And you may not believe it, but all this can be done while you're studying engineering if you'll accept these challenges.

1. View every written assignment as a chance to improve your skill in self-expression.

2. Pay attention to your rhetoric instructor. He knows the best way to teach you one of the most important skills you can master.

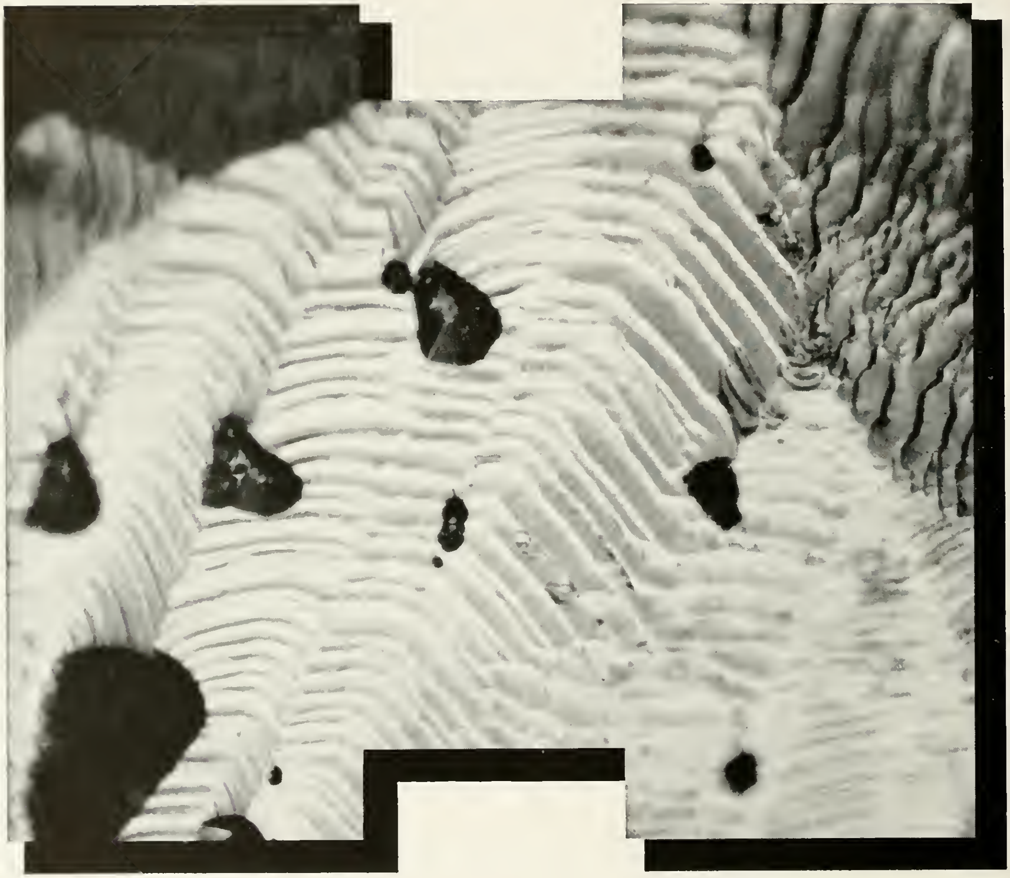
3. Try to fit in courses in public speaking, expository writing and business letter writing. Learn how to sell yourself and your ideas.

4. Take time out for an extra-curricular activity which requires you to communicate.

5. Write. Write as much as you can. Write letters to your parents, letters to your girlfriend, letters to the editor. Write it down. Take pride in the way you express every thought.

All set? Congratulations. You've overcome the greatest barrier in learning to communicate—the desire to do it.

The industry that



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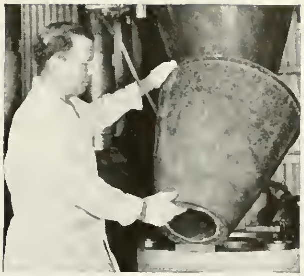

***Exit cones** capable of withstanding temperatures of 6000° F. represent one example of advanced engineering being performed by the Hughes Plastics Laboratory.*

This photomicrograph (at left) of an etched silicon crystal is used in the study of semiconductor materials. Impurities introduced into crystals such as this form junctions for semiconductor devices.

In the fast-growing semiconductor industry, Hughes Products, the commercial activity of Hughes, is leading the field. Its programs include basic research on semiconductor surfaces; alloying and diffusion techniques; and materials characterization studies to determine the electrical effects of imperfections and impurities.

In addition, Hughes Products is developing new semiconductor devices such as parametric amplifiers, high frequency performance diodes, and improved types of silicon transistors. New techniques are being devised for casting silicon into various configurations. Also underway is the development of new intermetallic compounds for use in semiconductor devices.

Other activities of Hughes provide similarly stimulating outlets for creative engineering. The Hughes Research & Development Laboratories are conducting studies in Advanced Airborne Electronics Systems, Space Vehicles, Plastics, Nuclear Electronics, Global and Spatial Communications Systems, Ballistic Missiles... and many more. Hughes in Fullerton is developing radar antennas which position beams in space by electronic rather than mechanical means.

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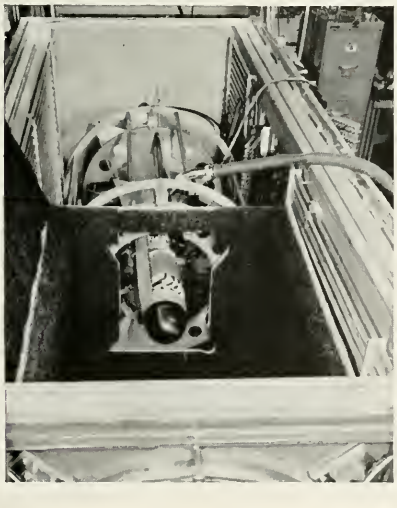

***Falcon air-to-air guided missiles,** shown in an environmental strato chamber are being developed and manufactured by Hughes engineers in Tucson, Arizona.*

IT'S LITERALLY ALL AROUND YOU!

The word *space* commonly represents the outer, airless regions of the universe. But there is quite another kind of "space" close at hand, a kind that will always challenge the genius of man.

This space can easily be measured. It is the space-dimension of cities and the distance between them . . . the kind of space found between mainland and off-shore oil rig, between a tiny, otherwise inaccessible clearing and its supply base, between the site of a mountain crash and a waiting ambulance—above all, Sikorsky is concerned with the precious "spaceway" that currently exists between all earthbound places.

Our engineering efforts are directed toward a variety of VTOL and STOL aircraft configurations. Among earlier Sikorsky designs are some of the most versatile airborne vehicles now in existence; on our boards today are the vehicles that can prove to be tomorrow's most versatile means of transportation.

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HUMAN CAPABILITIES *and* SPACE FLIGHT

By Milton Haefner

Introduction

In recent years, a frequently asked question has been, "Is it possible to put a man into space?" From a technical point of view, the answer to this question would be yes, a man can be put into space.

However, man is designed to exist within a comparatively limited environment. Due to his chemical and structural composition, he can tolerate only relatively small changes in this environment. Therefore, the question of putting a man into space is largely a question of whether or not man is capable of surviving in space. Looking at Figure 1, it can be seen that many of man's physical limitations and tolerances fall outside of the range of conditions which exist in space. From this, it is evident that if man is to survive in space, he must either adapt to his new environment or change the environment.

It is impossible to present here all the problems which must be faced and solved before man can enter into his new environment, space. Two important factors, however, which must be taken into consideration are man's tolerance to stress caused by acceleration and man's reaction to lack of weight both of which must be encountered if man is to accomplish space travel. Another consideration is the internal environment which must be maintained in the space vehicle if man is to continue to function efficiently. Decompression and radiation problems must also be taken into account when studying the possibility of survival in space. A less often considered aspect of the problem of man in space is the psychological-social problem which will be encountered due to confinement inside a small container.

Acceleration

These and other problems will now be considered in more detail. Due to the method by which man will be propelled into space, it is inevitable that he will be subjected to high acceleration forces. There are two factors which will greatly affect man's ability to tolerate this force. These factors are the position of the man relative to the direction of the acceleration and the duration of time for which the acceleration will last.

It has been calculated that during take-off of a three-stage orbital rocket, the passenger will be subjected to accelerations ranging from 3 G's for 10 minutes to 10 G's for 3 minutes. However, these are not the only acceleration forces which will affect the pilot of a space vehicle. For instance, in a turning maneuver at high velocity, normal accelerations as high as 40-50 G's may be experienced. These accelerations can, of course, be reduced by increasing the turning radius of the maneuver while holding the velocity of the vehicle constant (see Figure 2).

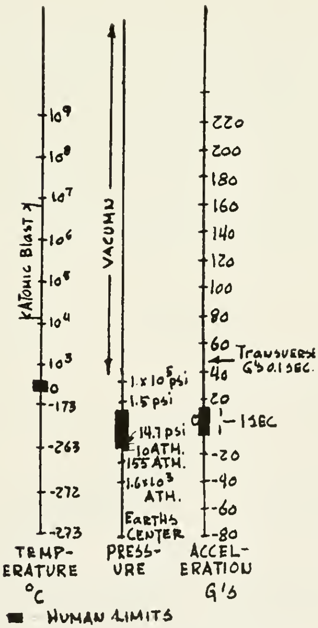

Figure 1: Man in the Physical World

Consider now how a man's tolerance to acceleration varies with the direction and duration of the force. When man is in the upright position, with the acceleration acting along his longitudinal axis, he has the lowest tolerance to acceleration. Refering to Figure 3, it can be seen that an acceleration of three G's sustained for a duration of one to two minutes would cause black-out. The cause of this condition is that the blood pressure is not great enough to overcome the added weight of the blood, and the blood then drains away from the eyes. Unconsciousness soon follows black-out.

There is, however, a significant increase in tolerance to acceleration when the subject is placed in a supine or prone position. The only difference between the supine and prone positions is that supine refers to lying face up while prone refers to lying face down. Again refering to Figure 3, it is seen that at ten G's acceleration, man's tolerance limit is now about three hundred seconds or five minutes. At an acceleration of three G's, a man's useful tolerance limit would be about six thousand seconds or one hundred minutes.

From the acceleration point of view, it then appears that the tolerance limits of man will not cause too serious an obstacle in the problem of sending man into space.

Weightlessness

Weightlessness is perhaps one of the most difficult orbital conditions to reproduce under laboratory conditions. There are only two ways in which it is possible to simulate this gravity-free condition. One of these ways is to place a body in a state of free-fall, and the other is to transport a body in an air-

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Turning Rate deg/sec	Radius Mi.	Time Min	G's ft/sec^2
3.0	80	1.0	35.6
2.0	120	1.5	24.0
1.0	240	3.0	12.0
.5	480	6.0	6.0
.25	960	12.0	3.0

Figure 2: Normal Accelerations Due To Turning Rates

craft which is describing a parabolic arc. Both of these methods of simulating the gravity-free condition have the obvious disadvantage that the time duration of the condition is too short to determine the effects of prolonged weightlessness.

There are, in general, two sides to the problem of weightlessness. The first is the more obvious physiological aspect, lack of muscular co-ordination and disorientation being two of the greatest factors.

Decrease in muscular co-ordination is expected to take place when the gravity free state is first experienced, but adjustment to this condition will probably occur within a relatively short time. This lack of muscular co-ordination is caused by the fact that man is normally accustomed to exerting a certain amount of muscular tension in order to accomplish some motion. However, in the weightless state, the same amount of force will result in more motion than is anticipated; the first attempts to compensate for this overexertion will result in decreased muscular co-ordination. The final answer to this question will not be known until an orbital vehicle is actually put into operation, because this alone will provide a gravity-free condition of sufficient duration for adjustment to take place.

Orientation depends on certain sensory organs, some of which depend on gravity for their stimulus, and, as a result, weightlessness will cause these gravity-sensitive preceptors to be ineffective. Nerve endings are one example of these preceptors; by indicating where the pressures due to weight are concentrated, they thereby indicate position. To clarify this statement, consider this example: if the soles of a man's feet detect pressure concentrations, he knows he is standing, while if the concentrations are distributed on his back, he knows he is lying face up. Another organ which aids the sense of orientation is the inner ear which again depends on gravity as a stimulus.

There is, however, one means of orientation which does not depend on gravity as a stimulus. This is visual orientation and it is believed by most authorities that this means of fixing one's position and motion with respect to the interior of the vehicle will largely overcome the effects of disorientation due to weightlessness.

In addition to the physiological problem, there is also the possibility of a psychological problem arising as a result of weightlessness. Since the first men to be chosen for space travel will be above-average physical specimens, there is the probability that they will also have an above-average interest in their bodies. There is a correlation be-

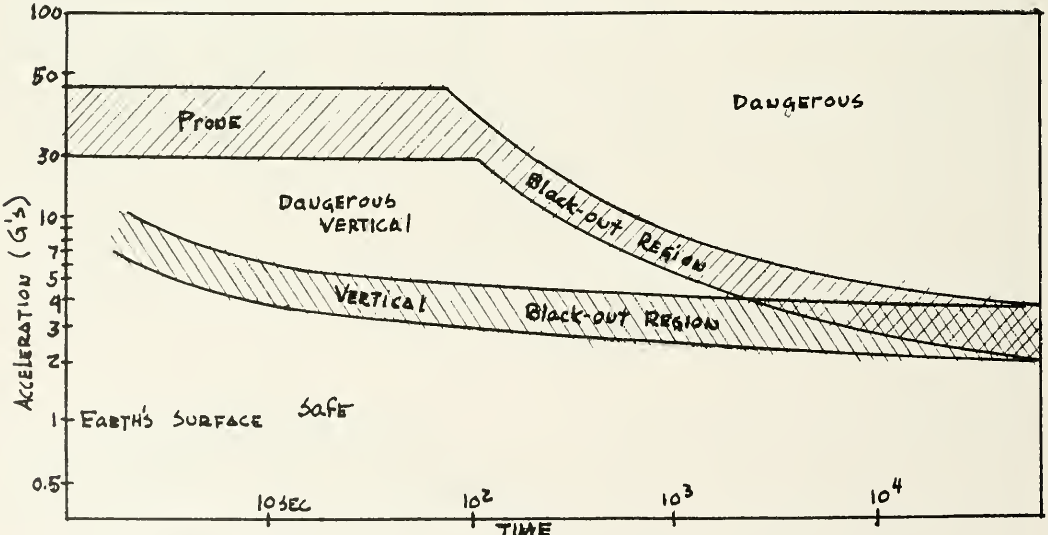

Figure 3: Human time-tolerance to acceleration

tween masculinity and physical attributes and as a result, lack of co-ordination may cause some concern as to loss of masculine traits. This may in turn cause some men to strive to regain their self-confidence by aggressive actions and bullying. Of course, in the close quarters of a space vehicle, this is intolerable.

Cabin Environment

If man is to survive and to continue to function efficiently in space, then he must be provided with an environment which, within moderate limits, will approximate that on earth. Pressure, temperature, humidity, and chemical composition of the atmosphere are the most important considerations in determining man's environment requirements.

There is a great deal of correlation between pressure and oxygen requirements. At sea level, 14.7 psi pressure with an oxygen content of 21 per cent is sufficient to provide man with needed oxygen supplies. However, as the total pressure of the atmosphere and the partial pressure due to the oxygen decrease, a greater percentage of oxygen is required. When the total pressure has been reduced to about 3.5 psi, 100 per cent oxygen is required to give the effect of sea level breathing. From a technical viewpoint, it is not feasible to consider a 100 per cent oxygen atmosphere and as a result, pressures considerably above 3:5 psi will have to be maintained. Ideally, sea level pressures would be desirable from the physiological standpoint, but the resulting pressure differential in space vehicles would provide serious structural difficulties.

The oxygen consumption rate of man depends on how hard he is working. Figure 4 gives some values of this consumption rate, a reasonable overall average being about 24 cu. ft. per day or 2 pounds per day. Corresponding to this oxygen consumption rate, about 21.6 cu. ft. or 2.5 pounds of carbon dioxide would be released per day.

It will therefore, be necessary to provide means of supplying oxygen and eliminating carbon dioxide. Since the first attempts at manned space flight will most likely be of short duration, the oxygen problem will probably be solved by storing a sufficient supply ahead of time. The carbon dioxide problem will most likely be solved by utilizing a chemical reaction which will absorb or decompose the carbon dioxide.

Temperature and humidity are also two important aspects of cabin environment. While man can withstand reasonable temperature extremes for a short period of time, it must be taken into account that man in space must be an efficient mechanism. In order for him to function properly for extended periods of time, provisions must be made to maintain a comfortable temperature-humidity level. The problem of heating due to friction will be accounted for by providing sufficient insulation and a possible heat sink. However, the amount of heat produced by the human body is approximately 3,000 cal. per day or about 12,000 B.T.U. per day. As a result, the same insulation which earlier protected the man may now cause him some discomfort if suitable air-conditioning is not provided. Perspiration will over a period of time, raise the humidity level if steps are not taken to prevent this. However, this can easily be overcome by use of chemicals which absorb moisture.

O_2 USED (per day/man)		CO_2 RELEASED (/day/man)	
cu. ft.	lbs.	cu. ft.	lbs.
19.2	1.59	16.8	1.9
21.6	1.79	19.2	2.2
24.0	1.99	21.6	2.5
28.8	2.39	26.4	3.0
33.6	2.75	31.2	3.6

Figure 4: Oxygen Consumption and Carbon Dioxide Release

Decompression

Most factors point to the desirability of employing a sealed cabin for manned space vehicles. However, in space this can cause a severe problem in the event of meteorite collision. While it has been calculated that the chance of collision with meterites of significant size is extremely remote, the problem must be considered.

Decompression means loss of pressures due to atmosphere and it is here meant to be a relatively fast loss of pressure. The physiological results of this decompression include hypoxia and decompression sickness.

Hypoxia, or oxygen starvation, is probably the more serious problem. Holes caused by meteorites would probably be of the order of one inch in diameter, and it has been calculated that with an initial pressure differential of 14.7 psi in a 500-cu. ft. cabin, hypoxia would occur in two minutes while total decompression would not occur for almost ten minutes. It can then be seen that the time it takes for hypoxia to occur would be the limiting factor when considering decompression effects.

Decompression sickness is the result of two things: lowered boiling points and gas expansion. From Boyle's Law it is known that as the pressure applied to a gas is decreased, the volume increases. Because of this, any gas which is trapped in tissues when decompression occurs will expand causing tissue damage. "Boiling of the blood" will also occur because the effect of lowering pressure on a fluid is to reduce the vaporization temperature. When the pressure becomes sufficiently low, normal body temperature becomes the boiling point of body fluids and bubbles will then form.

One possible solution to this problem is the use of emergency oxygen supplies which can be released to prevent decompression for a sufficient period of time for the crew to don pressure suits.

Radiation

Without the protection of the earth's atmosphere, which filters out most harmful radiation, man will be subjected to heavy cosmic and solar radiation.

Solar radiation, which is ultraviolet in nature, will cause severe sunburn and heating problems. Since man's first space ventures will most likely be accomplished entirely within the confines of the space vehicle, sunburn problems will perhaps cause some concern. It is hoped

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that the temperature control will be accomplished by making some areas of the vehicle radiation reflectors while other surfaces will absorb radiation.

Cosmic radiation is at present largely a matter of speculation. It is known that as altitude increases primary radiation (alpha, beta, gamma, etc.) also increases. It is believed that the effects of this radiation on man will be much the same as the effects of radiations which are found on earth. However, since heavy radiation shielding is impractical in space vehicles, the solution to this problem is not readily apparent.

Social-Psychological Problems

The most pressing psychological problems will be those of isolation and boredom. Once a space vehicle has been successfully put into orbit, there will be little for the crewman to do except for occasional monitoring of instruments. In addition, there will be physical restraints due to the restricted size of orbital vehicles.

Studies on the effects of sustained isolation and boredom indicate reduced intellectual capacities, emotional depression, and a tendency toward hallucinations. Of course, these conditions will be intolerable in prolonged space flights. There are however, various ways of overcoming, to a certain degree, the effects of isolation and boredom. Radio or television links with earth would greatly relieve the sensation of being separated from reality. Small games or problems which would present a challenge to man's intellect would also be of great help in relieving boredom.

As space flights increase in length and crews increase in size, the problem of inter-personality relations will be of interest. There is much truth in the adage, "Familiarity breeds contempt." Tests have indicated that even the best of friends can become enemies when subjected to each others company for 24 hours a day for extended periods of time. The solution to this problem is that enough room must be provided to assure each individual a certain degree of privacy. It has also been shown that personalities which are too evenly matched will not prove to be a good condition for extended periods of time. This brings up the possibility of mixed-sex crews because of the obvious personality differences. However, on flights of durations over a year's length, this could also produce some obvious difficulties.

Summary

While from a technical point of view, man in space is quite possible, physiological and psychological problems must also be taken into consideration before manned space flights are undertaken.

However, it would seem that most of these problems can be solved with present day engineering practices. It is hoped that satellite programs now in progress will shed light on some problems such as radiation effects and meteorite concentrations about which relatively little is now known.

With all problems taken into consideration, it is reasonable to make the statement "Man in space is possible."

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Motel Skyscraper

A motel building, 25 to 35 stories high and costing $18 million, is planned for downtown Fort Worth. Parking will be on the same floors as the rooms. The building also will include an auditorium seating 6,000 to 8,000 persons.

Help Wanted!

Positions are available on the editorial and production staff of The Illinois Technograph. Experience of this type is invaluable for personal satisfaction, job references, and development of creative skills. Applicants need not be engineering students. Interested persons may call the editor, Dave Penniman, at 2-4254 or leave their name at The Technograph office in 215 Civil Engineering Hall.

JOB OPPORTUNITIES OVERSEAS

The Myth and the Truth

By Judy Ondrla

Do you see yourself in a year or so with a degree in one hand and a suitcase in the other, boarding a transcontinental jet on the way to a job overseas? You have heard of fellows who graduate, join a firm and go to some ideal foreign country to represent that firm. You probably have thought, "What a setup! Get paid to travel! I'll have to find out about getting one of those jobs." And then perhaps your daydream went on to Italian wines or German beer or French women.

Lots of engineers dream of just the same thing. Mrs. Pauline Chapman, head of the engineering placement office, says each semester she is asked repeatedly about firms looking for men to relocate abroad and each semester she must tell many job hunters, there are NO opportunities for starting engineers overseas. The statement, of course, must be qualified. There are rare cases, but Mrs. Chapman and representatives of engineering firms who conduct interviews on campus prefer to take the absolute negative viewpoint because of the rarity.

There are two main reasons why a starting engineer is not sent overseas. One is economic, the other diplomatic.

Mrs. Chapman and a representative from Boeing Aircraft list the following reasons why few starting engineers have a chance for foreign employment. First of all, companies realize that recent graduates look upon an overseas job as a two-year paid vacation. They realize the engineer thinks of the job as a final "fling" before settling down to responsibilities of a wife, home and children. The companies know that the engineer doesn't want to work overseas more than two years. The engineers don't want to make a career of foreign work. It's a well-known fact that a person just starting with a firm cannot know everything he needs to know to represent the firm; therefore men with five or ten years' experience are much better investments. It's common sense to companies that they save money by sending an older, more settled and more experienced man overseas. Also most of the jobs available are top management positions that only experienced men are qualified to fill. Mrs. Chapman says she has talked with many company representatives on the subject of foreign employment. Almost every company, she says, wants at least five years' experience in the representatives; most ask for ten years.

Tied in with the economic savings mentioned above, the Boeing representative says that often an engineer who gets an overseas job doesn't want it for long. American firms overseas are mainly in countries like Saudi Arabia and South America. The Americans must lower their standard of living, and not many men can adjust. The men that do go over won't find large, clean homes with modern plumbing and refrigeration. The foods available aren't fresh vegetables or government inspected meats. He says most Americans, unused to the native diet, get sick when they eat the food.

The above are superficial reasons, however. The real reasons lie in the realm of diplomatic relations. When an American firm contracts with a foreign country to build a branch office in that country, the firm must agree to hire as high as 95 per cent native help. The remaining five per cent employed are, of necessity, Americans in a supervisory capacity. This again emphasizes the necessity of at least five years' experience.

Not only must 95 per cent of the employees be native, but there is an understanding between the firm and the government that as time passes, natives will be trained to take over these supervisory positions. The longer a company has been overseas, the smaller the need for American help.

Another source of native help to fill engineering positions overseas are the great numbers of men who come to the United States from a foreign country to get a degree. These natives, after receiving their degrees, go back to their homes. They will find any kind of job once they are home. These men literally sit around and wait for an American firm to open in the area. And these are the men that are hired. They are well-trained, qualified engineers. American firms can't afford to not hire these men; and the firm knows that these engineers are not just looking for a vacation. In most cases native engineers can be counted on as permanent help in that area.

One other strong reason for employing natives is the fact that it is just good business sense. Natives do a much better selling job to their own countrymen than any American could do.

Another main source of overseas engineering jobs is through the federal government. Tom Page, University representative in charge of placement with government agencies, says that an overseas job is not the first job an engineering graduate will get. He must first go through a training period. Government pamphlets on available jobs qualify openings for "mature, competent professional and technical specialists of recognized stature." These men are needed as "experts in the fields of engineering."

The closest a college graduate can get to a government overseas job is as a support specialist. Support specialists work with persons of recognized stature. But here, too, is a qualifier. These specialists must have "an excellent formal education (or its work equivalent) . . . and several years of professional work experience. . . ."

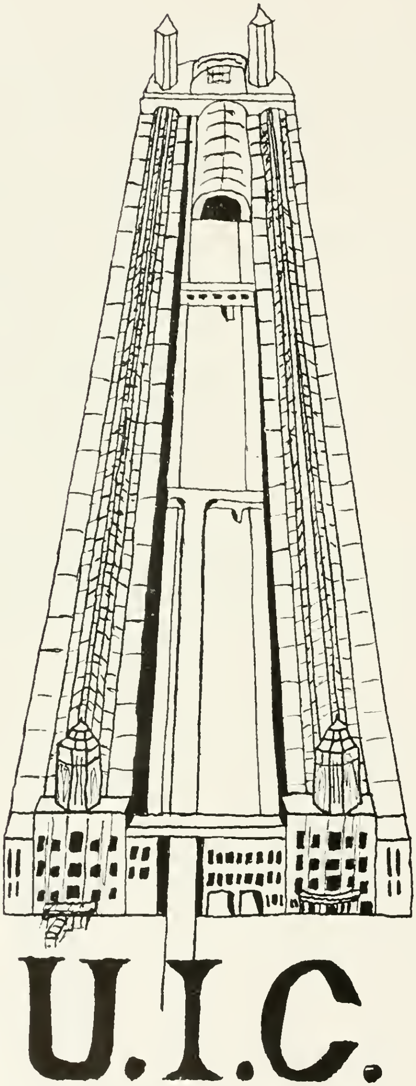
If you still want to go abroad, there are a few possibilities. Some of the national advertising of U. S. firms, published in *The Technograph* offers foreign opportunities. Look into these firms to find out what they are offering.

G. Brower, Boeing's representative, sees a somewhat optimistic future for overseas jobs, however. He feels that as industry develops overseas, so will job opportunities. There is a trend starting, he says, for companies to contract business in other countries. Several automobile and electronic firms are already setting up firms in Europe. Brower feels foreign aid and the United Nations' policies should bring some increase in jobs.

But the most practical thing is to resign yourself to at least five years' training here in the states. If you can prove yourself with your company, they may be anxious to send you as a representative.

Women in Engineering

By Eileen Markham



Have you noticed the shadow on engineering classes? What shadow?—that question is easy to answer if you've been reading the papers.

It seems that not enough women are entering the scientific professions. Statistics to prove this have appeared in almost all major news publications at some time during the month of December, 1959. So what?—the number of engineers, chemists, physicists and other technicians could increase by at least fifty per cent if the qualified women entered these fields.

Let's look at these facts rationally: *Do we need them?* Of all Russian engineers fifty per cent are women. (Russia has more engineers than the United States.) Less than one per cent of our engineers are women.

Do we need engineers? I'll leave that answer to your discretion. Just glance at the Sunday employment section of any major newspaper.

Can the women do the same work men are doing? With the exception of the jobs which involve heavy construction, engineering endeavors are not too physically demanding. The mental work can be done by any intelligent person with the proper training. And, since brains do not have sex, this can be achieved by a woman.

Oh! but, engineering is a man's field! Today it is. Tomorrow it needn't be. Girls may have to work harder to acquire those extra intuitive judgments which are part of a commonplace descriptive geometry situation. Yet, some of the world's foremost physicists and mathematicians were women. Even the men have produced no equal to Madame Curie who achieved two Nobel Prizes.

Why don't women enter engineering? Look at our own U. of I. Undergraduate Bulletin. The information on the engineering curriculum begins with a sentence about the training of "men" for engineering professions. For another thing, women are hesitant to enter the man's world. The competition is keen. It took over a hundred years for women to be accepted in medicine and law. (They are still frowned upon by many of their male contemporaries.) The same problem exists in engineering.

Surely, a more casual atmosphere exists in an all male class or place of work. But need this be reason for the instructor in a technical course to ignore or downgrade a woman student? These things have been known to occur. I, however, say NO to this treatment! Why? Because: We're needed! We're interested! We expect to earn our degrees and become qualified and capable members of an extremely vital profession. That is why we are engineers.

From the Pier . . .

SOLID ROCKET FUELS

By Mike Murphy

On the night of April 1, 1926, Dr. Jos. C. Patrick, a chemist and ex-physician, went into his laboratory to check on an experiment. Little did Dr. Patrick realize how important this experiment would be to the whole world. Dr. Patrick was trying to concoct a new type of automobile anti-freeze. Instead of finding a clear liquid which he expected, he found something that was dark and syrupy and having a smell like rotten eggs. Dr. Patrick viewed the experiment more or less as a failure. He used pieces of the unknown substance, which hardened upon cooling, for paperweights. In 1928 a man named Bevis Longstretch became interested in the substance which Patrick had named Thiokol, which is derived from the Greek words thio (sulphur) and kol (glue). It was found that Thiokol was impervious to petroleum and therefore could be used as an extremely efficient gasket for sealing gasoline tanks and other petroleum products containers. The two men searched for a place to open a factory but were refused many sites because of the sulphurous stench produced when Thiokol was processed. Finally they were able to set up a factory in Trenton, N. J. Business was generally poor but during World War II it improved because of the demand for gaskets for airplane fuel tanks. During the year 1941 the company made $89,000. It was not until after the war that the possibilities of Thiokol as a solid rocket fuel were investigated to any extent. Thiokol has been a leader in the field of solid fuels ever since that time. In 1958 the sales mounted to $2,-000,000.

Solid fuels have definite advantages over liquid fuels. They can be pocketed into smaller spaces because of their high density and the fact that the oxidizer is built in. There are few moving parts in the combustion chamber which reduces the chance of mechanical failure. Solid fuels rockets are easier to transport and easier to fire.

On the other hand there are several disadvantages to solid fuels. Solid fuels rockets are relatively less powerful than liquid fuel rockets. There is a chance that the "grain" or charge may crack and thus expose more surface area. This condition will produce erratic flight resulting from velocity changes. Another disadvantage is the fact that solid fuels misses are hard to steer. These problems are rapidly being solved and the future of solid-fuels looks good.

Due to the extensive research in the field of rocket propellents many different types have been developed in the past few years. Most of the present day rocket fuels deliver in the neighborhood of 200 lbs. of thrust for each pound of fuel consumed per second but higher values are rare. One example of solid fuel having more thrust is one which Allegany Ballistic Laboratory has been working on and is reported to be about 285.

A term known as specific impulse is generally referred to when solid fuels are being compared. Specific impulse is the impulse per unit mass of a propellant expressed in units of pound seconds per pound. The final height reached by a missile is proportional to the square of the specific impulse.

In regard to solid fuels specific impulse can be found by multiplying the thrust by the time and dividing by the mass of the propellent. Another factor which enters into the computing of the specific impulse is the operating pressure in the combustion chamber, or the ratio of the nozzle exit area to throat area, and on the outside pressure. To achieve space flight with chemical propellants we need those that give the most energy per unit weight.

The specific impulse of most solid fuels has increased by about 70 pound-seconds per pound, but there is little hope of passing 300 since the energy of solid fuel is rather limited. Some double-base and composite solid blends offer the best possibilities of exceeding 250 pound-seconds per pound, but 245 will be the probable limit for standard carbon-hydrogen-oxygen-nitrogen types.

Some of the more important solid fuels are Ballistite, NDRC, and Cordite.

Ballistite can be safely stored at 120 degrees F; its ignition temperature is 300 degrees F, and its flame temperature is about 5000 degrees F. The cost of this material averages five dollars a pound, but the specific impulse of 210 and the exhaust velocity of nearly 7000 feet per second are higher than those of the cheaper materials NDRC and Galcit. The exhaust velocities of the latter are 5150 and 5900 feet per second, respectively.

NRDC stands for National Defense Research Committee and is a composite propellant, fuel and oxidizer separate. It costs only one dollar a pound, for specific impulse of up to 180 pound-seconds per pound. The flame temperature is, however, only about 4,000 degrees F., and the burning rate is relatively low.

Cordite and Galcit are usually made up of organic polymer fuel and inorganic nonplastic oxidizers.

High exhaust velocities from some solid fuels have been reported in the neighborhood of from 4,000 to 8,000 miles per hour. These fuels, for the most part, possess undesirable physical properties.

One property of a solid fuel which is important to know is its burning rate. This figure tells the weight or amount of propellent consumed per second per square inch. Most burning rates are between 0.2 and 2.0 inches per second.

In order to reduce the thickness of solid fuel rocket walls, the charge has a hole from top to bottom. This hole is generally star shaped. The purpose of this is to permit the charge to burn toward the wall of the rocket. This situation permits the use of thin wall construction. By varying the geometrical shape and size of the hole different effects in power and burning time can be had.

Today more and more missiles powered with solid fuel are appearing. A few of these missle are the Sparrow, the Falcon, the Sidewinder, the Genie, the Dart, which is used against tanks and the Rat, which swoops down on subs. Familiar to many in various American cities is the Nike-Hercules. The recent success of the Polaris is further proof of the potential use of solid fuel.

More from

NAVY PIER

on Page 30

THE OTHER ROLE OF THE ENGINEER

As Illustrated from Problems of Highway Engineering

By Robert M. Jones

Besides the technical procedures involved in an engineering design, the engineer must consider both public relations and the aesthetic appeal of the project, for they will affect the success of his design. Often, the acceptance of a project depends upon the effectiveness of the exchange of ideas the engineer has had with citizens and citizen groups during the planning stages of the design and, sometimes more important, how the finished project looks to the eye of the public.

The engineer's public relations responsibilities can be summed up in a few paragraphs.

First, he must be able to get along with the public; it is, in effect, his employer, whether he works for a government agency, for industry, or for a consulting firm assisting government or industry.

Second, he must plan carefully enough and far enough ahead that he can explain his actions at any stage any time. In the case of highway design, such explanations would include why he chooses a particular route, why his design provides for drainage of storms which are likely to occur at only five year intervals, or why he sets a particular design restriction, as far as he is empowered, on the speed and use of a given section of highway.

Third, he must be able to fare successfully under the fire of public comment and criticisms which accompany his decisions. Such discussion often comes from organized citizen groups and newspaper campaigns in a form which tends to put the engineer on the defensive. He may thus be caught between two factions of opinion, but must work his way out while satisfying both sides. Of course, he should have anticipated and been prepared to answer many of the arguments against his decisions. It must also be realized that some problems are incapable of solution without hurting someone.

In justifying the construction of a highway, for example, the engineer must concern himself with the economic benefits to the whole area under consideration. In doing so, he must weigh all possible highway locations in relation to whether they provide the best service both for the overall region and the specific area through which the highway passes. Often these considerations are in conflict; he must then work out an equitable compromise. For safety, one particular location might require a reduction in the speed limit over a section of bridges and curves. This is opposed to the desirability of a higher limit which provides rapid flow through the entire highway network.

Preventing or limiting truck traffic on a parkway can cause troubles for the communities through which the trucks must then pass. Eventually the truck traffic becomes such a problem that it demands a new highway to take care of trucks.

A recent case in New England, Connecticut, in particular, involved the Merritt Parkway and the Wilbur Cross Parkway which, for many years, formed parts of the only multi-lane highway between New York and Boston. These parkways were restricted to passenger car traffic, and, even with such a restriction, were crowded. At the time they were built, shipping by truck had not become as large an industry as it is today. After World War II, the industry blossomed with numerous heavy trucks to take care of the increased volume of shipping. These trucks were forced to travel on U. S. 1, the Boston Post Road, through the centers of towns along the northern coast of Long Island Sound and on deeper into the state.

The inevitable effects on these towns were traffic congestion, confusion, and inconvenience, plus destruction of city streets with accompanying increased taxes for residents.

The result of a concentrated campaign for a solution to the problem was the Connecticut Turnpike. It was especially designed for trucks, though passenger cars are allowed if they pay the tolls.

The need for a highway such as the Connecticut Turnpike should have been foreseen at the time the two parkways were designed. Even if it was, the rate of growth of the trucking industry was probably not correctly forecast. As a consequence, the volume of traffic at which more highway facilities would be built was reached at an earlier date so the engineer was caught short.

In the middle of the Connecticut Turnpike situation was the highway engineer. He was expected to make everybody happy with his solution to the problems of routing, alignment, curvature, sight distance, and related subjects. Everyone, as usual, expected a dream highway which would neither disturb the towns through which it passed nor evict people from their homes. Since this as obviously impossible, the "other role of the engineer" played an important part in the development of the Connecticut Turnpike. There, the route passes through some of the most heavily populated and wealthiest counties in the nation; in addition, these counties are some of the most beautiful and historic in New England. Thus, the usual pressures were multiplied.

The engineer must be most careful in his relations with the owners of the prospective site of a highway. He must be certain he does not needlessly destroy any of our country's heritage in the form of old houses, historic sites, fine trees or beauty spots, and other places of sentiment.

In this light, he must be able to account for each of his design actions, such as why he chose to put an elevated section of highway in a metropolitan section rather than skirting the downtown area by building through the cheaper land of the slums. He must be able to explain, in terms that the layman can understand, why alignment, sight distance, and volume of excavation dictated this choice rather than ignoring the honest questions of interested though perhaps irate landowners.

Aesthetic Design Important

Besides achieving a functional design, the engineer must consider the effects the project will have on the people it is meant to serve. Beauty should be included, for although it sometimes costs more, the favorable reactions of the viewing and using public are well worth the added expenditure. It must be remembered that the work of an engineer will last for many years and thus should be aestically pleasing.

Highway bridges, for example, could be perked up by using unusual shapes or combinations of concrete, steel, aluminum, and other materials. Or, extremely simple though aesthetically balanced masses could be used.

Since concrete requires surface grooves to arrest and contain cracks, good architectural use might well be made of these grooves. With little or no extra cost, the grooves could be ar-

(Continued on Page 30)

IN AND AROUND CHICAGO

By SHELDON ALTMAN

More Modernizing

A new government center costing 63 million dollars will get top priority soon as the next project in the comprehensive plan for modernizing Chicago's downtown area. The project will house local government and is to be built in the block bounded by Washington, Dearborn, Randolph and Clark.

In February the mayor, heading the public buildings commission, is scheduled for a report that will give the "ok" for the project.

The project will consist of two 18-story buildings, and will house courtrooms for Superior, Circuit, and Municipal courts and additional local government office space. The remainder of the block will be a parklike plaza, with such facilities as a skating rink in winter. This is just one of many projects that will renovate the downtown area. The Metropolitan Exposition center on 23rd street and the lake is well under construction.

The first building will be a federal government skyscraper in the half block along the east side of Dearborn between Adams Street and Jackson Boulevard. After this is completed and is housing the federal courts and offices, the pressent United States courthouse bounded by Adams, Dearborn, Jackson and Clark will be razed to make way for the second building.

A project for consolidating the railway terminals and building the University branch on these 130 acres is also under consideration.

Big Nuclear Shipment to Chicago

A 1350-pound shipment of nuclear emulsion, largest order of its kind and worth $100,000 has arrived at the University of Chicago from England. Prof. Marcel Schein, physicist, and his associates in Operation Skyhook, plan to use the emulsion in a new study of high-energy cosmic rays.

It will be sent aloft in two giant balloons off the West Indies. The emulsion is highly sensitive material and will replace photographic plates in the gondolas of the balloons. They will be "stacked" to give a three-dimensional "track" of cosmic rays.

First Full-Length Picture in 43 Years

Chicago is on its way to becoming the midwest's Hollywood. For the first time in 43 years a full-length feature has been produced in Chicago. All concerned with the production are Chicago talent. This includes the producer, director, actors and technicians.

In recent years many studios have been engaged in the production of industrial, educational, public service and Armed Forces training films. Some Hollywood scenes and some television dramas have been shot here, but the recent completion of "Prime Time" marks Chicago's first effort to emulate the old days of 1916 and Essanay Studios.

Between 1897 and 1916, long before the first camera turned in Hollywood, Chicago was a major producer of feature films. Essanay Studio had people such as Charlie Chaplain, Gloria Swanson, Wallace Beery and Tom Mix working for them.

The title "Prime Time" is based on the concept of youth as the prime of life and is concerned with the problems of youth. When the script called for specific locations the film-producers searched out locations bearing the correct names within the Chicago area. When a teen-age hangout called "Luiga's" was needed a pizzeria was used with that name. Nightclubs and taverns in the area were also utilized. This city may soon be renamed "New Hollywood."

At The Pier

Some more new courses have been added for the benefit of engineering students. These include Math 315, Linear Transformations and Matrices; Math 342, Differential Equations, an introducductory course in partial differential equations and Physics 281, Intermediate Atomic Physics; Physics 322, theoretical mechanics. M.E. 221 is again being offered. It was first offered last semester. This is all part of UI's expanding program.

THE OTHER ROLE OF THE ENGINEER

(Continued from Page 29)

ranged in pleasing geometric patterns.

The highway right-of-way also needs much attention. Its landscaping, including informative signs, must be integrated with the natural surroundings. All should be at least as good as if not better than the quality of the overall area.

Economy Versus Safety

The engineer must seek an economical solution, but in doing so he sometimes plays a deadly game. When getting fill material for a highway, as an example, he has to balance one evil against the prospects of another. Borrow pits, as the sources of fill material are called, can also be accident and health hazards. While the cost of hauling material from an area where excavation is already necessary is sometimes more than the cost of excavating from a nearby field, the engineer must consider the effects of his decision to open a borrow pit.

Usually with a borrow pit, a field is lost from farming or from prospective home or factory sites. The proper use of a borrow pit should be both to provide fill material and to improve the effectiveness of the surrounding in looks and use.

If a low spot is created, water will collect during storms, proving a hazard to children and grownups alike as accidents can always be associated with pools of water. The standing water presents a health hazard as it can harbor mosquitoes and other disease-carrying insects. Also, it can pollute drainage waters which in time pass through the possibly contaminated water of a borrow pit.

These situations are seldom, if ever, desirable. Besides being a danger to all forms of life, they detract from the beauty of the highway vicinity.

Responsibility Lies in the Engineer

In short, the engineer has a high level of social and aesthetic as well as technical responsibility for his actions. The demands upon him are manifold, and do not stop with a purely practical solution to his problems. He works with people, and for the community; he must therefore consider all the effects of his creation on those concerned.

If he does so, he will find his services more in demand and his leadership more respected and sought. The reason is simple: when people have something good and are happy with it, they will want more of the same. But if they are displeased, they will be reluctant to purchase more such services or to appropriate money for similar projects. Again, the engineer must always remember that his work will be exposed to the public for many years; thus, his professional reputation is at stake with every decision he makes.

The best way for the engineer to help people and to keep them happy is to be honest, to show the engineering reasons for his decisions, and to fulfill his real role—that of diligently striving to make every design as socially desirable, technically efficient, and aesthetically pleasing as possible for the public. Only in this way can the engineer fill his true position of intellectual leadership in our society.

engineers

Automatic systems developed by instrumentation engineers allow rapid simultaneous recording of data from many information points.

Frequent informal discussions among analytical engineers assure continuous exchange of ideas on related research projects.

Under the close supervision of an engineer, final adjustments are made on a rig for testing an advanced liquid metal system.

and what they d

The field has never been broader
The challenge has never been greater

Engineers at Pratt & Whitney Aircraft today are concerned with the development of all forms of flight propulsion systems—air breathing, rocket, nuclear and other advanced types for propulsion in space. Many of these systems are so entirely new in concept that their design and development, and allied research programs, require technical personnel not previously associated with the development of aircraft engines. Where the company was once primarily interested in graduates with degrees in mechanical and aeronautical engineering, it now also requires men with degrees in electrical, chemical, and nuclear engineering, and in physics, chemistry, and metallurgy.

Included in a wide range of engineering activities open to technically trained graduates at all levels are these four basic fields:

ANALYTICAL ENGINEERING Men engaged in this activity are concerned with fundamental investigations in the fields of science or engineering related to the conception of new products. They carry out detailed analyses of advanced flight and space systems and interpret results in terms of practical design applications. They provide basic information which is essential in determining the types of systems that have development potential.

DESIGN ENGINEERING The prime requisite here is an active interest in the application of aerodynamics, thermodynamics, stress analysis, and principles of machine design to the creation of new flight propulsion systems. Men engaged in this activity at P&WA establish the specific performance and structural requirements of the new product and design it as a complete working mechanism.

EXPERIMENTAL ENGINEERING Here men supervise and coordinate fabrication, assembly and laboratory testing of experimental apparatus, system components, and development engines. They devise test rigs and laboratory setups, specify instrumentation and direct execution of the actual test programs. Responsibility in this phase of the development program also includes analysis of test data, reporting of results and recommendations for future effort.

MATERIALS ENGINEERING Men active in this field at P&WA investigate metals, alloys and other materials under various environmental conditions to determine their usefulness as applied to advanced flight propulsion systems. They devise material testing methods and design special test equipment. They are also responsible for the determination of new fabrication techniques and causes of failures or manufacturing difficulties.

NEW ENTRANCE REQUIREMENTS FOR ENGINEERS

By Dean D. R. Opperman

September, 1963, has been approved by the Board of Trustees as the effective date for the new entrance requirements into the College of Engineering at the Chicago Undergraduate Division and at Urbana. These new requirements are the result of a year long study made by a group of engineering faculty men on the Urbana campus. Their recommendations were subsequently approved by the engineering faculty and the senate on the Urbana campus and by the engineering faculty and senate at the Chicago Undergraduate Division located on Navy Pier.

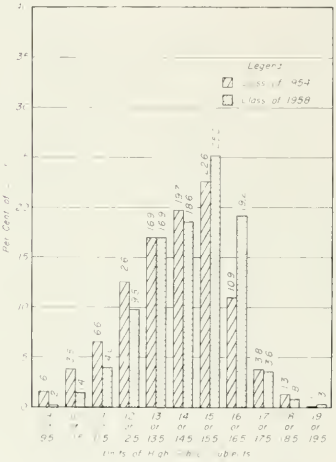
Many interesting facts were discovered in the study made by the Urbana faculty members.

Students entering the College in Urbana as new freshmen have been presenting more entrance credits than required by the College and the University. Further, the trend is for each succeeding class to enter the College better prepared than the class previous to it. A good example is found in mathematics.

In the fall of 1954, 70% of the entering freshmen presented at least 3½ units in mathematics. (A unit is one year of study in one course.) Four years later, in September 1958, the number of students presenting this number of credits climbed to 79%. Last fall, September 1959, the figure rose another 3% to 82%. We feel confident that this trend shown by prospective engineers to take more and more mathematics will continue in the future. The credit for the trend should be shared equally between the College of Engineering which has demanded more mathematics and the high schools which have responded with excellent college preparatory mathematics programs. Last fall several new freshmen received advanced placement in differential calculus and a few students received advanced placement and began their mathematics studies in integral calculus, the second semester calculus course!

Similar trends to take more subjects than required in high school have been shown to exist in other fields of instruction generally considered as college preparatory work. Increasing numbers of students are taking a full four years of English in high school, more foreign language, more science. The increases in all of these areas are noteworthy if we compare the class entering in 1954 with the class entering in 1958. The result of these stronger college preparatory programs is shown dramatically in the accompanying graph.

The University of Illinois requires a minimum of 9 units of college preparatory subjects of admission. The remaining 6 units required for admission may be in any area acceptable to the



Total units of high school subjects in foreign languages, the social sciences, mathematics, the sciences, and English, presented by freshmen entering in fall of 1954 and fall of 1958.

high school for graduation. This graph indicates that very few students entering in either 1954 or 1958 presented only a minimum of 9 college preparatory subjects. A large number of the students presented from 13 to 16 units of this nature, an impressive fact when 16 units is all that is required for graduation in many high schools. However, the most significant feature of the graph is the comparison between the classes entering in 1954 and 1958. Those students presenting smaller numbers of credits in college preparatory subjects are in the majority in the class of 1954. The class of 1958 came far beter prepared than the class of 1954 with respect to 15 through 19 or 19.5 units. Several conclusions can be drawn from the graph.

1. High school students are receiving better and better counseling each year with regard to programs of study that will prepare them for college studies.
2. At the present time, entering students are presenting far more "solid" subjects than required for entrance by the College of Engineering or the University of Illinois.
3. A student who minimizes college preparatory subjects in high school will be at a distinct disadvantage when paced in competition at the college level with students who have given thought to their high school programs and have chosen wisely the subjects they will need for their college work.

As a result of these rather intensive studies of the background of the students who entered in 1954 and 1948, definite recommendations were made, and approved, to strengthen the entrance requirements to the College of Engineering. These new entrance requirements, effective in September 1963, are as follows:

Subject	*Required Units*	*Recommended Additional Units*
English	3	1
Algebra[1]	2	
Plane Geometry	1	
Trigonometry	½	
College Preparatory Mathematics		as available
Science[2]	2	1
Social Studies	2	1
Language[3]	2	as available[4]

[1]Students who have only one unit in algebra and one unit in plane geometry may be admitted on condition that the deficiency is removed in the first year.

[2]Required science must include two units from physics, chemistry, and biology. Botany and zoology may be substituted for biology. General science may not be used as a required subject.

[3]Required language must be two units in one language. Students deficient in language may be admitted on condition that the deficiency is removed during the first two years.

(Continued on Page 36)

(*Continued from Page 34*)

'It is recommended that additional credit be earned in the same language that was presented for entrance credit. However, if the two units of required language are Latin, additional credit should be in a modern language.

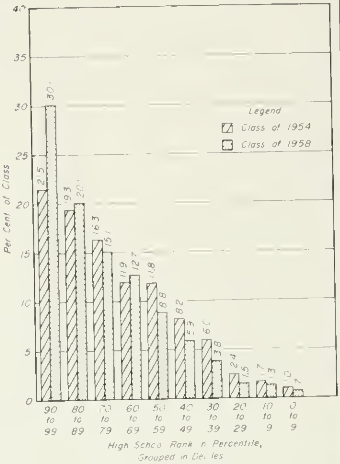
The mathematics and English requirements for admission have remained unchanged from what they were. The additions to the entrance requirements are two units of language, two units of social studies, and two units of science. Large numbers of students are already presenting two units of science and therefore this new requirement will not demand too much modification in the programs of the high school students. Over 80% of the students entering in 1958 presented two units of social studies although one or one and one-half units are required for graduation from high school. Therefore, a number of prospective students who intend to enroll here will be required to add one-half or one unit of social studies to their programs.

The requirement that will entail the most adjustment in high school programs is the new requirement in language. Over 55% of the students in 1958 presented 2 units of credit in language, but as the new entrance requirements indicate, this figure should rise to close to 100% by September of 1963. No student will be barred admission to our College because he does not have language credit since provision has been made to make up this deficiency during the first two years at the University of Illinois. However, the deficiency will mean that the student will have to add approximately one semester to the time normally required to earn his baccalaureate degree in engineering.

Increasing numbers of engineering students are continuing in college for graduate study after they have received their bachelor's degree. Everyone recognizes the value of foreign language in helping graduate students study more effectively. Since German, French, and Russian are the languages in which most of the significant technical literature is published, a study of one of these languages can be of immense value to an engineer. However, Spanish or other languages specified by the University may be used for entrance credits. Failure to study language before a student reaches the graduate level will only hamper his progress and delay his graduation with a master's or doctor's degree.

Another important reason for studying a foreign language is its contribution to the student's grasp of the meaning and structure of his own language. Many engineers have trouble communicating with other people, though their record is no worse than any other group of professional people. Foreign language studies will help the engineer write more effectively and, therefore, indirectly contribute to his future success.

One last item of significant information uncovered by the study should be brought to your attention. Though this information has no bearing on the new entrance requirements, it still should be of interest to students planning to go into engineering. The following graph, which indicates high school rank, shows that more and more students of engineering are coming from the upper half and only extremely small numbers are from the bottom quarter of their high school class. Larger numbers of students are coming from the upper ten per cent



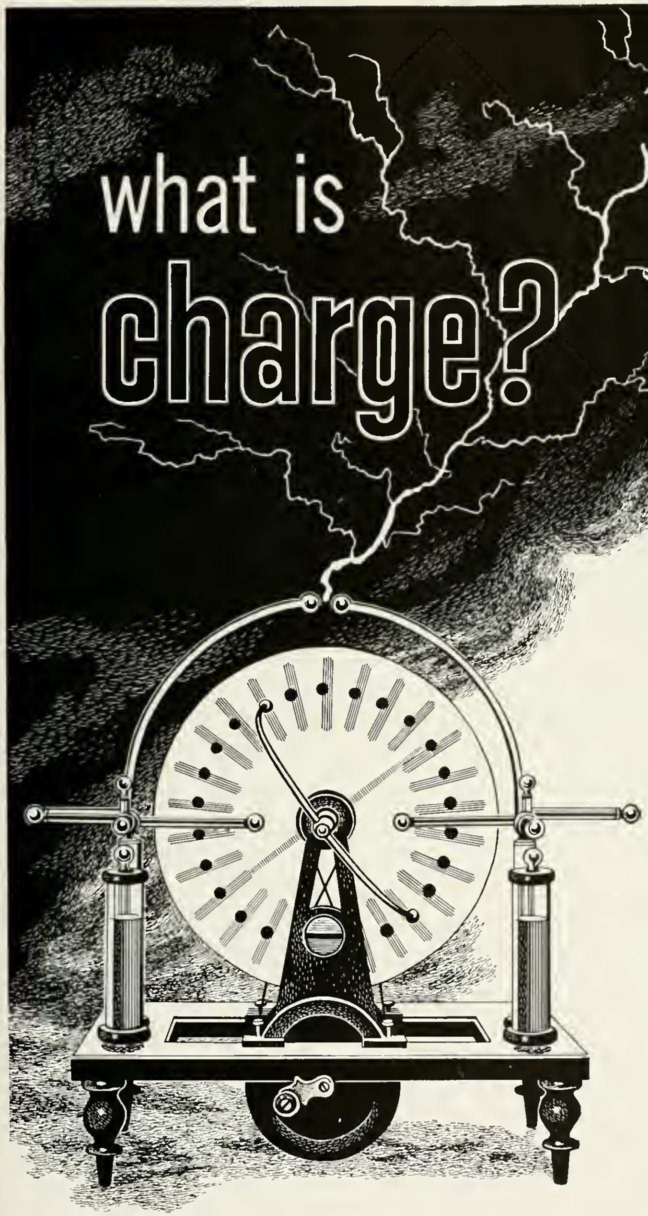
Rank in high school class of freshmen entering in fall of 1954 and fall of 1958.

of their high school class each year. In September of 1959, 34 high school valedictorians were among the students entering engineering at Illinois!

It should be pointed out, however, that this garph shows nothing whatever as far as the success of these students in college is concerned. I firmly believe, though, that the prospective engineer should know that achievement in high school is an important indicator of success in later college work and this graph is one measure of achievement.

This article has not been written to inflate the ego of the present engineering students or to scare prospective students out of enrolling in engineering. However, every incoming student should realize the importance of a sound high school education. The new entrance requirements are designed to help prepare prospective students for the challenge and the thrill that will be theirs the day they first enroll in engineering.

what is charge?



Earth's attraction for a lightning bolt?

+ or −, which is up?

A resonant phenomenon?

A singularity in a field?

What is the nuclear "glue" for like charges?

A better comprehension of charge is important to Allison because energy conversion is our business and charge is one keystone for this conversion work. Thus we have a deep and continuing interest in electrons, protons, positrons, neutrons, neutrinos—charge in all its forms.

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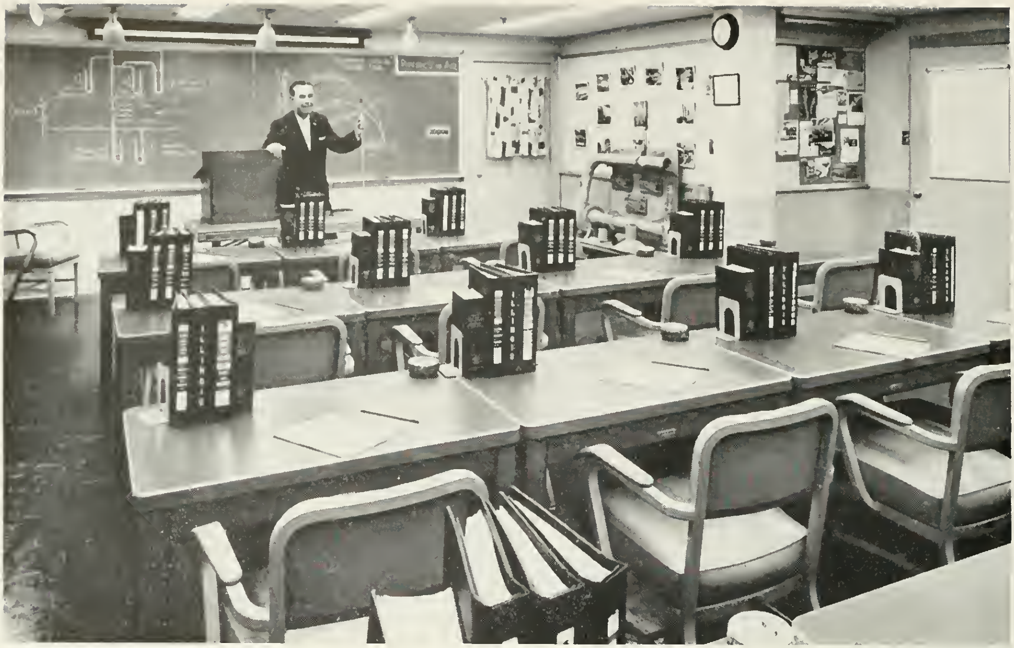

The Inscription

By Helen Geroff

I boarded my ship and waved to the crowd outside. In five minutes, I would have to pull the lever which would release the rocket blast and take me off into the unknown. As I gazed out of the porthole, I saw the faces of my loved ones. They were proud of me, I was sure, but their haggard faces revealed the same fear that I had. Would we ever meet again?

I threw one last kiss and pulled the lever. The ship lunged forward and lifted me high into the sky. My fingers turned the panel dials almost automatically. My training had been long and exhausting, and now, I only hoped that I could remember everything.

As the moon came closer and closer into focus, I prepared to land. I radioed back to Earth that everything was functioning satisfactorily and that I would be checking in with them at regular intervals. My landing on the moon was very smooth. I made one last check of the panel controls, donned my oxygen mask, opened the ship's door, and set out.

I walked around collecting rock and dust samples for several hours. When I was almost ready to go back to the ship, I noticed a cave. I was getting tired, but I remembered hearing the scientists say that if man was ever to live on the moon, he would probably have to live under the ground, so I decided to look inside.

With pencil and note pad in hand, I began to explore the cave. I had not walked more than twenty yards when I came upon a man-made door, at least it looked man-made. On the door, a strange inscription was written in several languages. Excitement swelled inside of me. Here was something man had talked of finding but had never really hoped to find.

Moving as fast as I could, I ran back to the ship. With trembling hands, I tuned in the radio, focused the telescreen, and relayed my findings and the inscription to my superiors.

The commander's voice came over the radio loud and clear, "Stay where you are. We have called in some experts on languages, and they will translate the message if possible. You will hear from me again when we receive the translation. Over and out."

I waited anxiously for Earth's reply, but when it came, I found myself totally unprepared to receive such a message.

"This is Earth calling. The inscription reads as follows: 'The Earth will be blown to bits during their nuclear war. Any Earth-man reaching the moon before the start of the war will remain alive if he stays in this cave. A ship from Venus will pick up any possible survivors three days after Earth's destruction.' "

"Your orders are to remain in that cave. Russia has just declared war on the United States and . . ."

As I leaned closer to the radio, I heard a terrific explosion, and the voice died away.

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GENERAL DYNAMICS

— Photos by Dave Yates

Technocutie . . .

MARION HILLER

Bevier Hall and the school of Home Economics claim freshman, Morion Hiller, most of the time, but the engineers on compus cloim her os their February Technocutie.

From Evonston, Marion calls Allen South her home on campus; but Saturday afternoon she lives ot the Turk's Heod listening to Hockenhull. An alternate on occasion is the Capitol for the jam session.

Morion likes outdoor sports, tennis being her fovorite with woter skiing and sailing coming in second. But she also admits she is enjoying learning to play chess.

Sweets ore Marion's fovorite food. She laughingly admits she doesn't core for meols, but loves eating between them. Lobster tail rates high with her; milk is her favorite beverage.

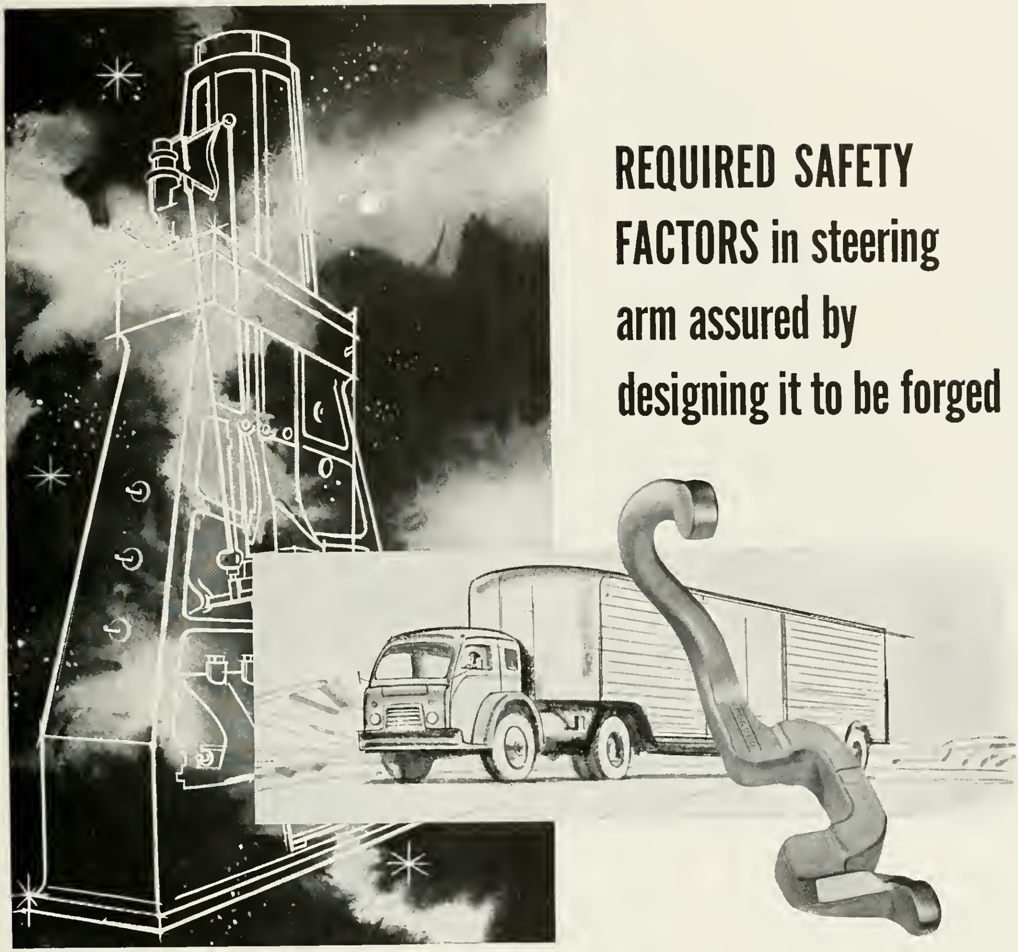
Informol dates are the kind Morion likes most: movies, the beach in the summer, parties with close friends. She's always reody to dance.

Egotisticol and unottentive men are Marion's pet peeve. She also rotes low the type that call and soy, "I'm here; come on down." A sense of humor in a fellow goes far with her.

Men's clothes are neat to score with Morion. In the winter she loves to see sweaters. She likes Ivy League clothes but would do owoy with the belt idea. Cotton slacks and wash pants instead of Levis are olso a must.

With a millionaire's budget, Marion would travel; she would like to see the much-heard-obout places, especially Russio.

Marion is not sure what she will do when she graduates perhaps go into retoiling or textile research. In the meantime, she will study and have fun.



Typical steam forging hammer

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The Thing That Couldn't be Done

By Stephen Lucas

Somebody said that it couldn't be done,
But he with a chuckle replied
That "maybe it couldn't," but he would be one
Who wouldn't say so till he'd tried.
So he buckled right in with the trace of a grin
On his face. If he worried he hid it.
He started to sing as he tackled the thing
That couldn't be done, and he did it.

—Edgar A. Guest

They said it couldn't be done; they said nobody could do it. Sounds familiar, doesn't it. "Gunsmoke" is interrupted at least three times a week by that catchy little phrase to which is added a plug for Liggett and Meyers L & M cigarettes. Most of us though are so worried about whether Matt Dillon will catch that week's varmit that we don't think seriously about the present implication of those twelve words — they said it couldn't be done; they said nobody could do it.

Throughout his brief presence on earth, man has attacked many problems which couldn't be done, and done them. One does not have to think too long to come up with such examples. Man was not made to fly and he certainly could not in a heavier than air machine; yet the Wright brothers did it. It was impossible for one person to talk to another many miles away; but Alexander Bell did it. A ship driven by a tub of boiling water — impossible, the people said; they were amazed when Fulton's *Clermont* did it.

That's very nice, you are probably saying to yourself, but I knew all this before. True, I say, this is not my point; my question is, can we keep the impossible jobs of today and tomorrow as our forefathers did? Can we, who are in colleges and universities of the United States, tackle the job that couldn't be done and do it? I am not sure we can, and I shall attempt to explain why and to offer a few suggestions on how we can remedy the situation of which I speak.

In *The Organization Man*, William Whyte takes several chapters to explain his views on the effect of education in turning out the organization man, the man who is happy to find his safe little niche in life and stay there away from the worries and insolvable problems of life. The Wall Street Journal, in an early March editorial, noticed that more employers wanted their prospective employees to have a wide and diversified

training. The editorial went on to say that presently colleges and universities were graduating tradesmen or human machines with the characteristic lack of drive and vocational interest that Whyte often observed. To come a little closer to home, Mrs. Frayn Utley, wife of Clifton Utley, well-known news commentator, and famous herself as a news commentator, last week at the annual professional journalism honorary banquet said, ". . . schools of journalism are not providing enough background education. They are turning out technicians."

What does all of this mean? What am I trying to say? I am saying that the universities and colleges are not turning out the thinking man, the man who has a wide and varied background in all or most fields, the man who when confronting a problem knows what to do when parts of the solution are not in his field, and the man who can and will tackle any problem because his mind has not been channeled and persuaded that the problem cannot be done. I am saying that the men and women graduated today are not the well-rounded men and women they believe themselves to be.

The three sources noted above are only a sample of the many persons, groups, and publications which cite the poor education being obtained in colleges and universities. It is relatively simple to say that something is definitely lacking in college education today; but, it is much harder to advance even a partial solution to this difficult problem. Before setting down suggestions, I should like to advance two statements: the first to explain what education should not be, and the second to generally outline what it should be.

The late Albert Einstein once remarked, "There is born into the minds of all men an intense curiosity and desire for knowledge, but for most people, this is soon educated out of them." And Vice President and Provost of the University, Gordon Ray, commented last year at the Men's Independent Association Awards Banquet that the aim of college education is not the amassing of information, but the enlarging of mental capacities to enable an individual to use the information he gained at college.

With these two statements in mind, let us see what could be done to actually educate, and not train, the people attending our colleges and universities. First, the undergraduate curriculum should consist of basic and general courses. A large amount of technical and specialized courses should only be taught in graduate schools. A possible solution to the old complaint about the narrowness of engineers would be to make engineering curricula of five year duration. The present trend of undergraduate engineering schools, which are most often accused of not offering a well-rounded course of study, is to continually keep adding more technical and specialized courses to the already overloaded undergraduate program. If the engineering school at this university were changed to a five year school, it is almost a certainty that the extra year would be composed almost entirely of more technical courses, although the main reason many educators and personnel directors in industry would want an extra year for engineering education is to add the lacking non-technical or liberal arts courses. Several of my instructors have mentioned that many of the present engineering courses were taught in graduate school when they went through their schooling. These courses have now pushed their way into the undergraduate's curriculum, often, I am afraid, at the expense of a non-technical or liberal arts elective. Some work should be definitely done in this area to stop the trend of technical specialization and turn it into a trend of education.

Second, several required courses in present or contemporary world events should be offered by colleges and universities to all of their undergraduates. A very noticeable trend in our nation at this time is the ignorance and disinterest of the people in world, national, and local affairs. This lack of interest and knowledge is quite evident in the campus counterpart — student government. Student Senate at this university has long admonished the student for his apathy in governmental affairs. Perhaps Student Senate could work in conjunction with the university in offering these courses in government and world affairs and use the university as a small model on which the students on this campus could practice and learn.

Third, a series of one course in contemporary, creative, or out-of-field writing should at least be offered and possibly be required in certain colleges. Tau Beta Pi recognizes the need for this type of practice and education in requiring as a pledge duty the writing of a non-technical essay of which this paper you are reading is an example. The recognition of this problem, however, does not necessarily bring about a solution. Those engineers elected into Tau Beta Pi do need this type of experience; but, surely the other people in engineering need this experience as much if not more than those persons actually participating as pledges. A course of this type should be required of all engineers, possibly a full year after Rhetoric 102. This program would be applicable to other colleges whose graduates also need a good command of spoken and written English in fields other than their own area of specialization.

Educators prominent in this area could certainly come up with more profound suggestions than those which I have offered; yet, I feel that these several suggestions expanded and fitted into the present educational system here are certainly needed in the light of comments similar to the ones previously advanced and to the readily apparent dissatisfaction of industry with present college graduates. With our present world becoming so specialized and technical, we must make sure that our college graduates do not become just a small cog or bolt in the great machine of American technology. Our college graduates must be educated, prepared to think and solve the complex problems of our day which cut across many fields and specialties. If we do not start to remedy this problem of education very soon, the bigger, impossible problems of our society might be approached as observed by this take-off on Edgar Guest's aforementioned quote;

They gave him the job that couldn't be done.
He smiled and went right to it.
He tackled the job that couldn't be done.
And found that he couldn't do it.

Pirate's Pirate

The theft and republication of books by Russia has long angered Western authors and publishers—and now the Soviets themselves are learning how it feels from the Red Chinese. The Chinese Communists have proved to be pirate's pirates by stealing and reprinting not only Western books but Russion texts as well.

Melon On A Stick

Watermelon on a stick may be the newest national frozen confection fad next Summer if a Texas company is able to expand its opertaions fast enough. The company now ships chilled "melon squeezings" in 4,000 gallon tank trucks to dozens of creameries and other plants in its area for final processing.

Alcohol With Water Chaser

A slug of alcohol may play a significant role in bringing approximately 150-billion barrels of untapped U. S. oil to the surface. A professor of petroleum and natural gas engineering believes the alcohol slug, followed by a waterflood, may be one solution to the oil industry's secondary recovery problem.

HE MAKES HIS ENGINE STALL

...so yours won't!

Charles Domke has one of the world's most unusual jobs. He *tries* to have engine trouble!

He's a Project Automotive Engineer at Standard Oil. In all kinds of weather—hot, cold, wet, dry, low barometer, high barometer—he goes driving. First thing you know, he'll stop and change fuel, put in a different blend of gasoline to see what happens. If it stalls, he doesn't call a tow truck. He just puts in another blend of gasoline.

You might say he *makes* his engine stall... so yours won't!

What Mr. Domke and other automotive engineers learn from these constant experiments is used to give you gasoline that is blended especially for the region of the country in which you live and also for the season.

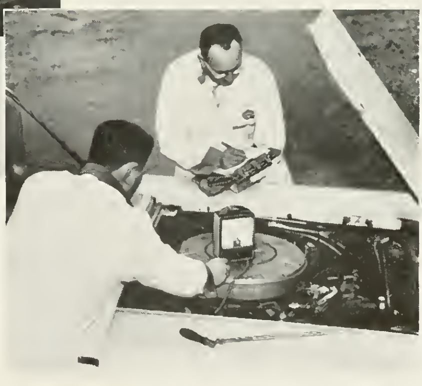
It may surprise you to learn that *12 or more seasonal changes* are made in Standard gasoline every year! It is adjusted for temperature, humidity, altitude and other factors that affect gasoline performance in your area.

A pioneer in petroleum research, Standard Oil is famous for its "firsts" in petroleum progress. Since our first research laboratory opened 70 years ago, our scientists have been responsible for many major petroleum advances—from making a barrel of oil yield more gasoline to discovering a way to get more oil out of the earth.

Charles Domke and other scientists at Standard Oil and its affiliated companies are searching continually for ways to make oil products serve you better... to make petroleum *more useful to more people than ever before!*

What makes a company a good citizen?
For a company, good citizenship is more than obeying the law and paying taxes. It is looking ahead, planning for the future, making improvements. America has grown to greatness on research conducted by private business for the benefit of all.

Charles Domke (right) is one of the few men we know who takes a positive delight in having his engine stall in sub-zero weather. He and Mechanic Verland Stout change gasoline blends frequently. When the engine stalls, they try another blend. Their objective, of course, is to find the perfect gasoline under various climatic and road conditions—and the true test is on the road itself!



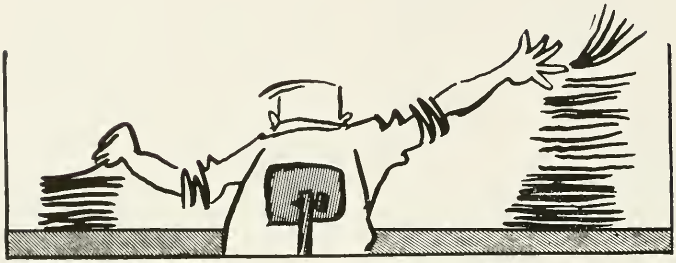
The gasoline that performs best in icy conditions will cause engine difficulty in hot weather. Standard gasoline formulas are changed twelve times a year to assure peak performance in every season. Mixtures also differ from one geographical location to another in order to offer customers more gasoline value for their dollar.

STANDARD OIL COMPANY

STANDARD

THE SIGN OF PROGRESS.
THROUGH RESEARCH

Skimming Industrial Headlines



Edited by The Staff

Seven Tips on How to Get Better Results from Tape Recorder

Your daughter has such a sweet little voice that you simply must put it on tape. You do—and she sounds like a beatnik on a binge.

This can be avoided if you follow these seven hints on how to get better results from your tape recorder.

1. Avoid hand-holding the microphone. Mike stands, both floor and table models, are preferable. Don't place the microphone on the same table with the recorder or on a piano, radio or TV cabinet.

2. Make sure to record at the proper volume level. Too high or too low levels will create distortions.

3. Record the speaking voice at a speed of 3.75 ips. But it is advisable to record music, both vocal and instrumental, at 7.5 ips.

4. To avoid feedback, place the microphone so that the sound from the speaker is not directed toward it. Keep the mike away from audible hum fields such as those produced by fluorescent lamp ballasts and the like.

5. Keep tapes away from excessive heat and dampness, and do not store tape near electrical appliances or motors which may generate magnetic fields.

6. Do not wind the tape too tightly when you store it. Be sure the tape is wound evenly, and make sure to rewind at least once every six months.

7. Don't be afraid to experiment and make mistakes. One unique advantage of a tape recorder is that you erase mistakes simply by re-recording.

Survey on Engineering Writing Under Way

A survey to find what management is doing to help technical people communicate better is being made by the Technical Writing Improvement Society (TWIS). Underlying the survey is the desire to find why industry is not doing more to help their key professionals—particularly engineers — write better. The survey results are expected to show if the reasons are financial, lack of instructors, lack of books and other teaching materials, etc.

Questionnaires are being sent by TWIS to more than 1,000 of the country's top firms in all industries. The survey is being directed by John L. Kent, TWIS Executive Secretary. TWIS is a national organization of educators, trade journal editors, industrial writers and editors, and management people, founded in 1955.

In announcing the survey, Kent said that industrial management is one of the four factors which educators feel have a bearing on the quality of writing. The other three are (1) the engineer himself, (2) the editors who accept engineers' writing, and (3) the schools and colleges which have helped educate the engineer.

Results are to be published by TWIS this June.

New Repellents

A dust-repellent for paint and a water-repellent for clothing are promising new developments. The paint-protector is a colloidal silica preparation that "fills the pores of a paint surface to produce a slickness so total that there is virtually nothing for dirt to adhere to." The water-repellent treatment "withstood seven days of continuous 24-hour rainfall without showing any water penetration."

Mobile Lounge

Passengers at the now-abuilding Dulles International Airport outside Washington, D. C., will be ferried from terminal to planes in "mobile lounges." The vehicles will be self-propelled, have controls at both ends for travel in either direction, and be self-leveling to adjust to airliner door sills. Average passenger trek from car to plane will be cut from 1,600 to 350 feet.

Electronic Warehouse

A giant Milwaukee mail order house has slashed its two biggest costs—paperwork and physical assembly of orders—by an estimated $250,000 a year through automation. Two electronic computing systems used to sort and process orders have enabled a reduction of the firm's warehouse staff from 200 to 20.

Fish Finder

A Massachusetts electronics company has developed a portable depth and fish finder for use by sports fishermen in boats as small as dingies. The transistorized fathometer can operate off a portable battery or the battery of a power boat, has a depth range of 120 feet, and will pin-point both bottom depth and any intervening schools of fish.

New TV Tube

A pale green glow emitted by the radar screens is the only source of light in an airport radar room. All day, every day, observers in this darkened room scan the scopes to insure that air traffic is safely routed.

Without disrupting these vital operations, WDSU-TV, Channel 6, New Orleans, recently took its viewers into the radar room of the new Terminal Building at Moisant International Airport. The telecast from this darkened room was made possible by the use of General Electric's new super-sensitive television camera tube.

The event was one of a series of highly successful local "remote" telecasts using this type GL-7629 image orthicon for black-and-white for the first time in regular on-the-air service. WDSU-TV technicians were amazed by the ability of this tube, to pick up a usable picture in absolute minimum "existing light" conditions.

New Orleans' St. Louis Cathedral, on historic Jackson Square, was the site of another important telecast using this new image orthicon. WDSU-TV's traditional Christmas Eve telecast of Midnight Mass was marked by the best results ever this year. Understandably, the use of TV lights for this remote is out of the question. Engineering personnel were prepared to switch to a regular type 5820 tube if the light conditions in the Cathedral caused disturbing "burn-ins," or "highlights." However, no change was necessary; results were excellent.

The new tube also was used on a telecast from the Christ Church Cathedral, a location with very little available light. Again, the picture quality was far better than could be expected with the "5820" tube.

Still another "night-into-day" success story was chalked-up during the WDSU-TV coverage of the dramatic Democratic primary run-off on January 9, in which Jimmy Davis defeated deLesseps Morrison. A one-camera remote from the Jefferson Parish courthouse picked up reactions of crowds and candidates that were missed during first primary coverage using a regular tube.

WDSU-TV Chief Engineer Lindsey Riddle was well pleased with the results obtained with the new tube during the remote telecasts and studio experiments.

Radioactive Waste

The nuclear energy industry can develop in a rational way without being "bottle-necked" or "hamstrung" by trouble in disposing of radioactive wastes, an Atomic Energy Commission spokesman said.

Addressing a University of Illinois sanitary engineering conference that has "Radiological Aspects of Water Supplies" as its theme, J. A. Lieberman, chief, Environmental and Sanitary Engineering, AEC Division of Reactor Development, said:

"The management of radioactive wastes which includes their handling, treatment and disposal is a general problem whose thread runs through the complete fabric of nuclear energy operations. . . .

"In the peaceful day-to-day application of the benefits of nuclear technology, the disposal of radioactive wastes potentially represents perhaps the major 'non-beneficial' effect on the public and its resources.

"More money probably has been spent, and more scientific and technological effort concentrated on facilities, operations, and research with regard to this industrial waste than on any industrial contaminant we have known. At the present time at Atomic Energy Commission installations, there is an investment of approximately $200,000,000 in facilities for the handling, treatment and disposal of the wastes, while the estimated annual operating cost for these facilities is approximately $6,000,000."

Methods of keeping waste from having harmful effects center around two major concepts, "concentrate and contain" and "dilute and disperse."

Lieberman stressed that "the management of disposal of radioactive wastes is not a single problem with a single solution. It varies widely, depending upon the specific nature, concentration and quantity of radioactive materials involved, and on the specific environment in which it must be considered."

However, some methods which are being used with some effectiveness in varying kinds of situations include:

—Use of the "diluting power of the environment to some extent in handling low-level waste.

—"Conversion of waste to solids by one of several methods.

—"Storage of solids in selected geological strata with major emphasis on salt beds.

—"Disposal of liquids into geological strata—either deep wells or salt beds.

—"Disposal of liquids or solids into the sea.

"The conversion to solids and storage of these wastes in salt formations seemed to be the most favored possibility at this time," Leiberman added, referring to recent Washington hearings on the subject.

"Although one has to be very careful to distinguish between aspiration, reality and speculation in this field, it is our own strong feeling that the development program has thus far found solutions to some of the waste problems and at least indicated solutions to others."

The U. of I. Sanitary Engineering Conference is conducted by the U. of I. Department of Civil Engineering and Division of University Extension, with the Division of Sanitary Engineering, Illinois Department of Public Health. Proceedings will be published.

Milling During Transfer

Exhaust manifold castings can now be completely finished in a machine that not only saves floor space but permits simple alterations to meet part design changes. Designed and built by The Cross Company, Detroit, Mich., this machine mills all flange faces of manifolds while they are being transferred and does machining operations in both stations. Any change of the tailpipe flange angle — which usually changes with each new vehicle model — can be accommodated by changing the fixturing and the angle of just one head in one of the stations.

A two-position fixture, mounted on the shuttle, is loaded with two parts in the first station. One raw casting is clamped with the four exhaust port flanges up. A partially finished casting is turned end for end, rotated approximately 90 deg and clamped with the tailpipe flange up. The fixture locates the unmachined part on cast surfaces and will accommodate normal casting variations. The semifinished part is located by two milled surfaces and two drilled holes.

After the automatic cycle is initiated, the pallet moves to the second station. During the transfer, the parts pass under and are machined by three inserted-blade carbide-tipped milling cutters. The exhaust port flanges pass under a roughing and finishing cutter. Only one cutter is needed on the tailpipe flange since finish requirements are not as rigid because the tailpipe fits into a machined opening, directing the hot gases away from the gasketed joint.

In the second station, the tailpipe flange holes of the raw casting are drilled by an angular head. The same holes in the semifinished part are tapped by tools mounted on the same short vertical column as the milling cutters. With normal part design changes, it would only be necessary to change the angle of the tailpipe flange-drilling head. Because of standard component design, this is a compartively simple matter. Fixturing changes would depend on the angular change.

The parts are shuttled back to the first station in rapid traverse for the final machining operations. To prevent scuffing of the milled surfaces, the milling cutters are lifted about 1/8 inch during the period of the return movement.

In this station, the eight exhaust port flange holes of the raw casting are drilled and the central opening in the tailpipe flange of the semifinished part is finished with a two-step boring tool using carbide cutters.

At the end of this automatic cycle, the operator removes the finished part, transfers the semifinished part to the second fixture position and inserts a raw part in the first position. Each back-and-forth cycle of this machine produces one finished manifold and the production rate is 20 parts per hour at 100% efficiency while producing truck manifolds.

Space 'Bicycle'

Spacemen may spend a good part of their time pedaling. One researcher says a human passenger in a space vehicle could supply some of his own power by a pedal operated generator to save the weight and space used by other power sources such as batteries. In addition, it would provide a form of exercise and possibly help relieve tension.

"Fenton! Quick!"

BRAIN TEASERS

Edited by Steve Dilts

A familiar type of logic poser may be called the "colored-hat" variety after the following best - known example. Three men: A, B and C, are blindfolded and told that either a red or a green hat will be placed on each of them. After this is done, the blindfolds are removed; the men are asked to raise a hand if they see a red hat, and to leave the room as soon as they are sure of the color of their own hat. All three hats happen to be red, so all three men raise a hand. Several minutes go by until C, who is more astute than the others, leaves the room. How did he deduce the color of his hat?

* * *

Another class of popular logic puzzles involves truth-telling and lying. The classic example concerns an explorer in a region inhabited by the usual two tribes; the members of one tribe always lie, the members of the other always tell the truth. He meets two natives. "Are you a truth-teller?" he asks the tall one. "Goom," the native replies. "He say 'Yes'," explains the short native, who speaks English, "but him big liar." What tribe did each belong to?

* * *

When Professor Stanislaw Slapenarski, the Polish mathematician, walked down the down-moving escalator, he reached the bottom after taking 50 steps. As an experiment he then ran up the same escalator, one step at a time, reaching the top after taking 125 steps. Assuming that the professor went up five time as fast as he went down (that is, took five steps to every one step before), and that he made each trip at a constant speed, how many steps would be visible if the escalator stopped running?

* * *

An absent - minded bank teller switched the dollars and cents when *he* cashed a check for Mr. Brown, giving him dollars instead of cents, and cents instead of dollars. After buying a five-cent newspaper, Brown discovered that he had left exactly twice as much as his original check. What was the amount of the check?

* * *

Brainteasers courtesy *Scientific American*.

The answers for these brainteasers will appear next month. The answers to last month's problems follow.

* * *

The amount spent by each individual is a square number, and the difference of the expenditure within each family is 63 shillings. The first step is to find 3 sets of squares that differ by 63. The required numbers are:

$32^2 - 31^2 = 63$

$12^2 - 9^2 = 63$

$8^2 - 1^2 = 63$

The integers in the first column represent expenditures by the husbands; in the second column, by the wives. Now we have to pick the integers that differ by 23 and 11. It is easily seen that Anna (31) is the wife of Hendrick (32); Katrun (9) is the wife of Elas (12); Gurtrun (1) is the wife of Cornelius (8).

* * *

30	39	48	1	10	19	28
38	47	7	9	18	27	29
46	6	8	17	26	35	37
5	14	16	25	34	36	45
13	15	24	33	42	44	4
21	23	32	41	43	3	2
22	31	40	49	2	11	20

* * *

The required number is enormous, but it can be found by "brute force."

Since we do not know how many digits there are in the required integer, we will represent them by A, B, C . . . as read from right to life. Then the integer is one of form as follows:

(1.) $A+10B+100C \ldots +10^{n-1}Z$

where *n* is the number of digits.

Let us take A as the terminal digit to be transferred. When it is placed at the other end, the integer becomes:

(2.) $B+10C+100D \ldots +10^{n-2}Z$
$10^{n-1}A$

The stipulation is that (1.) is to be 4 5 of (2.). (Remember that the digits are represented in reverse of the way they are written.) Then—

(3.) $A+10B+100C \ldots +10^{n-1}Z= 4\ 5\ (B+10C \ldots +10^{n-2}Z+ 10^{n-1}A)$

Clearing of fractions and expanding, we have—

(4.) $5A+50B+500C \ldots +5 (10^{n-1}Z)= 4B+40C \ldots +4(10^{n-2}Z)+ 4(10^{n-1}A)$

Now collect the A terms on the right, all other terms on the left—

(5.) $46(B+10C \ldots +10^{n-2}Z)= A[4(10^{n-1})—5]$

From (5) it follows that the right-hand member is divisible by 46. In other words we must find values for A and n such that—

(6.) $\dfrac{A[410^{n-1})—5]}{2 \times 23}$

will be integral. Since the expression in brackets is odd, it is not divisible by 2; therefore A is divisible by 2, and we can write—

(7.) A=2, 4, 6, or 8

Since A is not divisible by 23, the expression in brackets must be. The expansion of this expression for values of n 1, 2, 3 . . . gives 35, 395, 3995, etc. To find the first of these terms divisible by 23, set up a long division in form—

(8.) 23) 399 . . . 95(17 . . .
23
———
169
164
———
59 etc.

Bring down 9 from the dividend each time, until a remainder of 11 is reached, so that the final 5 can be brought down (since 115 23×5). This turns out to be a lengthy matter, but it is mere arithmetic. The smallest quotient obtainable is—

(9). 173,913,043,078,260,869,565

By taking A=2, we have the smallest integer that satisfies the conditions:

(10). 2,173,913,043,078,260,869,565

Three other answers can be obtained by setting A equal to 4, 6 and 8. In each case, as is seen from (6.) number (9.) has to be multiplied by half of A to make up the balance of the integer.

* * *

The minimum number of sets that could have decided the tournament was 15, totaling 90 games (4). One extra set was played in the first round (3), leaving one game to be accounted for. One set in the tournament must have been won by 7-5. Bancroft lost his first match by 6-4 and 7-5 (7.) Franklin reached the finals where he lost (8.)

Since he won the unique 7-5 set, his first-round opponent was Bancroft.

Other first round pairings were Abercrombie vs. Devereau (5), and Gormley vs. Eggleston (9). The remaining two entrants must have been paired: Haverford vs. Chadwick.

The winners in the first round were Haverford (3), Franklin (8), Eggleston and Devereau (6).

In the second round Eggleston did not meet Haverford (1), nor did he meet Franklin, for Franklin vs. Bancroft and Eggleston vs. Gormley were in different halves of the original bracket (2). Therefore, Eggleston met Devereau, and Haverford met Franklin. The winners were Devereau (6) and Franklin (8).

Devereau won the final match from Franklin by 6-4, 6-4, and 6-4 (8).

Gulls Plague City Dump

Gulls may force Duluth, Minn., to close its city garbage dump. The scavenging gulls, defying bombs, buckshot and thicker coverings of dirt, are considered a hazard to planes using a nearby airport. They have flown into jet intakes and collided with radar equipment.

Paint Kills Bugs

A paint that kills insects which alight on it recently has been developed. The paint is applied by conventional techniques. Insect-killing power is said to last as long as the paint itself.

Electronic 'Old Man'

New Hampshire's famous "Old Man of the Mountains," the natural rock formation that inspired Nathaniel Hawthorne to write "The Great Stone Face," is being protected from the weather by modern electronic equipment. Engineers have installed strain gages on the steel rods used to reinforce the stone face to measure shifts in the formation of the rock.

Belt Saves Roads

Old conveyor belts, which had been discarded by a mining firm, now are being used to protect the surface of a road from tractor-type machinery. The company's operations lie on either side of a black-top road and the old belts, laid across the road, prevent crawler-type machinery from damaging the pavement. However, the belting does not interfere with normal road traffic.

Rumpus Room Shelter

The latest twist in bomb shelters is a walnut paneled room designed to serve as a guest room, rumpus room or workshop when not being used as a shelter. It uses the basic design approved by the Office of Civil Defense Mobilization, but it adds such refinements as convertible sofas, vinyl floors, finished walls, a television set and cabinets.

Hat Radio

Latest idea in company communication is a two-way radio in a safety helmet which has a sound-cancelling microphone for effective transmission when surrounding noise level is high. The radio, about the size of a cigaret pack and weighing two pounds including two small batteries, has a 1,000-foot range.

Arctic Buildings Self-Rising

Two huge steel buildings that pull themselves up by their own bootstraps—in this case, built-in hydraulic jacks—are features of new Distant Early Warning Line construction in the Arctic. The two-story, 133-by-144-foot structures stand on "stilts" 19 feet above Greenland's ice cap and are raised by the jacks three feet each year. This keeps them from being buried by drifting and accumulating snow, which builds up on the cap one yard each year.

Steam Welding

Steam welding is the latest idea in shieded-arc systems—where gases usually are used to protect the weld from impurities such as oxygen—in the Soviet Union. Russian engineers say tests show that water vapor becomes a protective medium—providing a large quantity of moisture at the joint—that prevents weld porosity and improves over-all quality.

Robert K. "Buck" Moffett, University of Alabama '55, knows from personal experience the opportunities engineering journalism can offer. If you're interested in growing within your chosen field, he's the man for you to contact.

Begged, Borrowed, and . . .

Edited by Jack Fortner

THE LIFE OF A JOKE

Birth—A freshman thinks it up and laughs out loud, waking two Sophomores in the back row.

Age 5 minutes—Freshman tells it to a Senior, who answers: "It's funny, but I've heard it before.

Age 1 day—Senior turns it in to a college magazine as his own.

Age 2 days—Editor thinks it's terrible.

Age 10 days—Editor has to fill magazine, so joke is printed.

Age 1 month—Thirteen college comics reprint it.

Age 3 years—Seventy-six radio comedians discover it simultaneously and tell it accompanied by howls of mirth from the boys in the orchestra ($5.00 per howl).

Age 10 years—Professors start telling it in class.

* * *

A motorist broke down in a lonely part of Illinois pork country and found refuge for the night in a farmhouse. The next morning, his breakfast was served a large bowl. As he ate he found that he was verrrry popular with a small pig which kept nuzzling him affectionately.

The farmer's explanation—"Wal, it ain't you the pig likes. It's jest that you're a-using his bowl mister!"

* * *

Salesman: "This model has a top speed of one hundred miles an hour and she'll stop on a dime."

Prospect: "What happens after that?"

Salesman: "A little putty knife comes out and scrapes you off the windshield."

* * *

The unusually high birthrate in a suburb near our city as recently explained. Every morning at 6:15 the express comes roaring through town blowing its whistle.

It's too early to get out of bed, and too late to go back to sleep.

* * *

The Technograph is a great publication
The school gets all the fame,
The printer gets all the money,
And the staff gets all the blame!

The Professor of English and the Instructor of Engineering were dining together in the Faculty Cafeteria. During the course of the meal the former spoke:

"I had a rather peculiar answer in class today. I asked who wrote the 'Merchant of Venice,' and a rather young freshman replied, 'Please, sir, it wasn't me!"

"Ha ha ha!" laughed the Engineering Instructor. "and I suppose the little rascal did it all the time."

* * *

A young engineer took his girl to an open air opera one beautiful, warm, summer evening. During the first act he found it necessary to excuse himself. He asked the usher where the men's room might be found.

"Turn to your left, and walk down to the big oak tree, and there it is."

The young engineer did as he was told and in due time returned to his seat.

"Is the second act over yet?" he asked his girl.

"You ought to know," she replied, "you were in it."

* * *

A girl finished with her bath and was just stepping on the scales to weigh herself. Her husband returned home unexpectedly and entered through the back door. Seeing what his wife was doing as be passed the bathroom door, he exclaimed, "Well, dear, how many pounds today?" Without turning her head, she replied, "I'll take 75 pounds today, and don't you dare pinch me with those tongs."

* * *

Three eminent doctors were bragging among themselves one day. Said the first, "I grafted an arm on a fellow and now he plays tennis like a pro." Said the second, "I grafted a leg on a man and now he runs on the Olympic team." The third took the cake with, "I once grafted a smile on a jackass and now he is in Student Senate.

* * *

Some girls go in for necking—others go out for it.

* * *

Who was that lady you were obscene with last night?

A patient at a mental hospital who had been certified cured was saying good-by to the head psychiatrist.

"And what are you going to do when you get out in the world?"

"Well I may go back to U. of I. and finish my CE course. Then, I liked the Army before, so I may enlist again. He paused a moment and thought. "Then, again, I may be a teakettle."

* * *

He grabbed me by my slender neck
I could not yell or scream.
He dragged me to his bedroom
Where we could not be seen.
He threw aside my flimsy wraps
And gazed upon my form.
I was cold and chilly,
He was nice and warm.
He pressed his feverish lips to mine
I could not make him stop.
He drank my very life away—
I could not call a cop.
He made me what I am today—
Hated, used up, thrown away.
That is why you see me here—
An empty broken bottle of beer.

* * *

The eager relatives gathered for the reading of the will. It contained one sentence: "Being of sound mind, I spent every damn cent I had."

* * *

A wise man has observed that people who live in glass houses shouldn't. But then, they might as well—everyone knows they do.

* * *

A small boy leading a donkey passed a Marine camp. A couple of marines wanted to have some fun with the lad. "What are you holding on to your brother so tight for sonny?" said one of them.

"So he won't join the Marines," the youngster replied.

* * *

Student: Why didn't I make 100 on my history exam?

Prof: You remember the question, "Why did the pioneers go into the wilderness?"

Student: Yes.

Prof: Well, your answer, while very interesting was incorrect.